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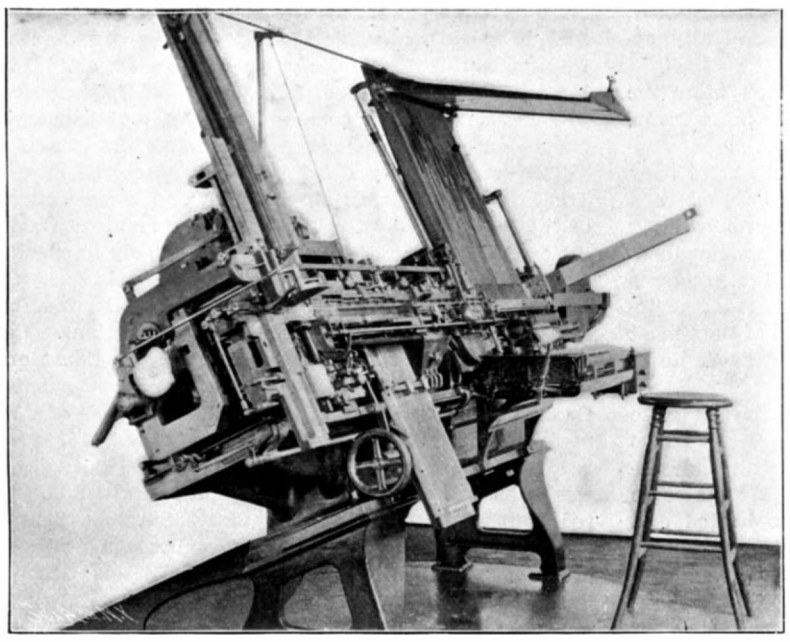
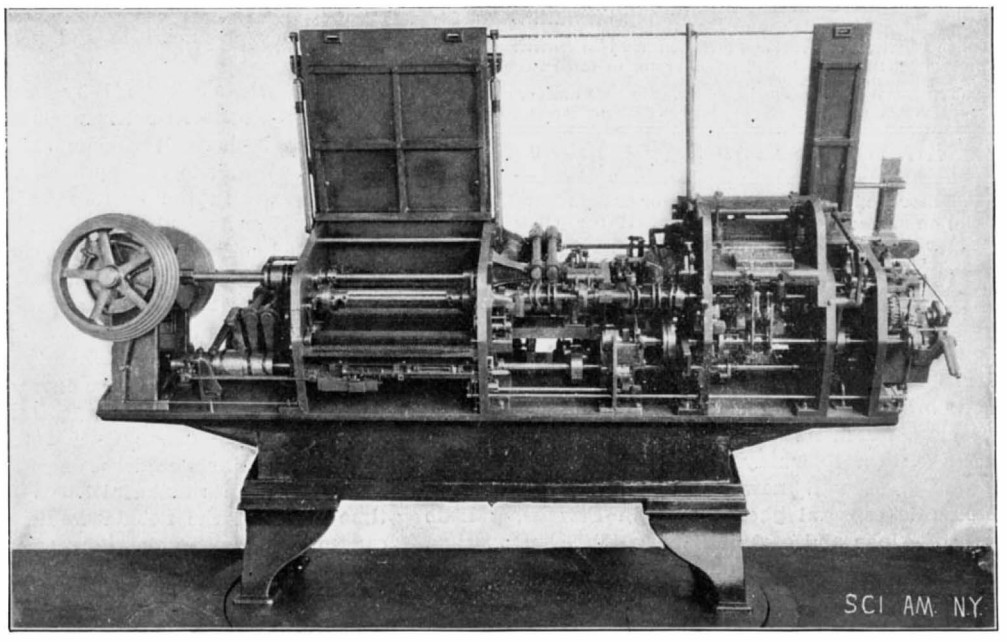
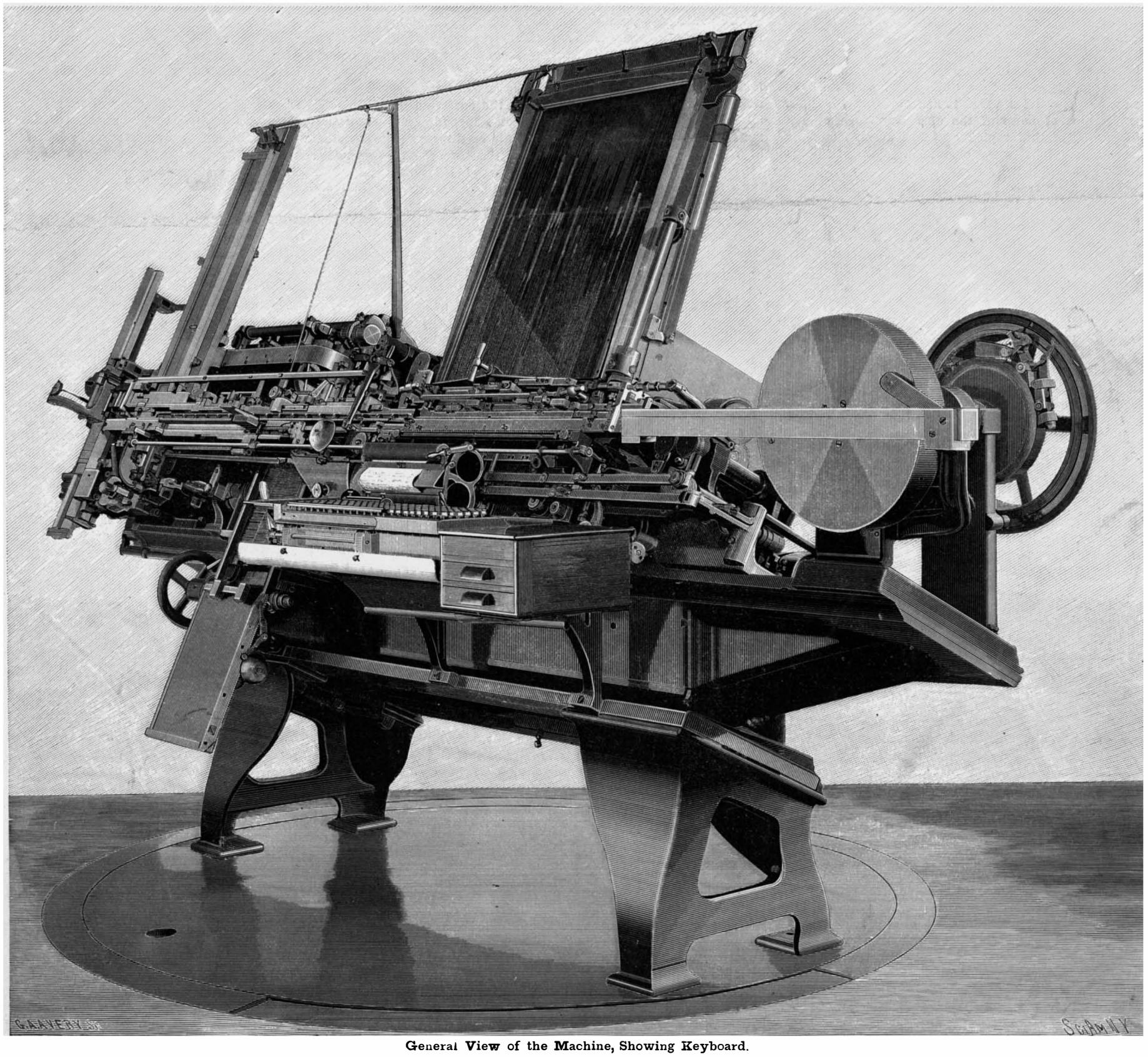


Front View of the Typesetting Machine.



Rear View of the Machine, Showing Mechanism.



General View of the Machine, Showing Keyboard.

A MACHINE WITH 18,000 ELEMENTS—THE PAIGE TYPESETTING MACHINE.—[See page 150.]

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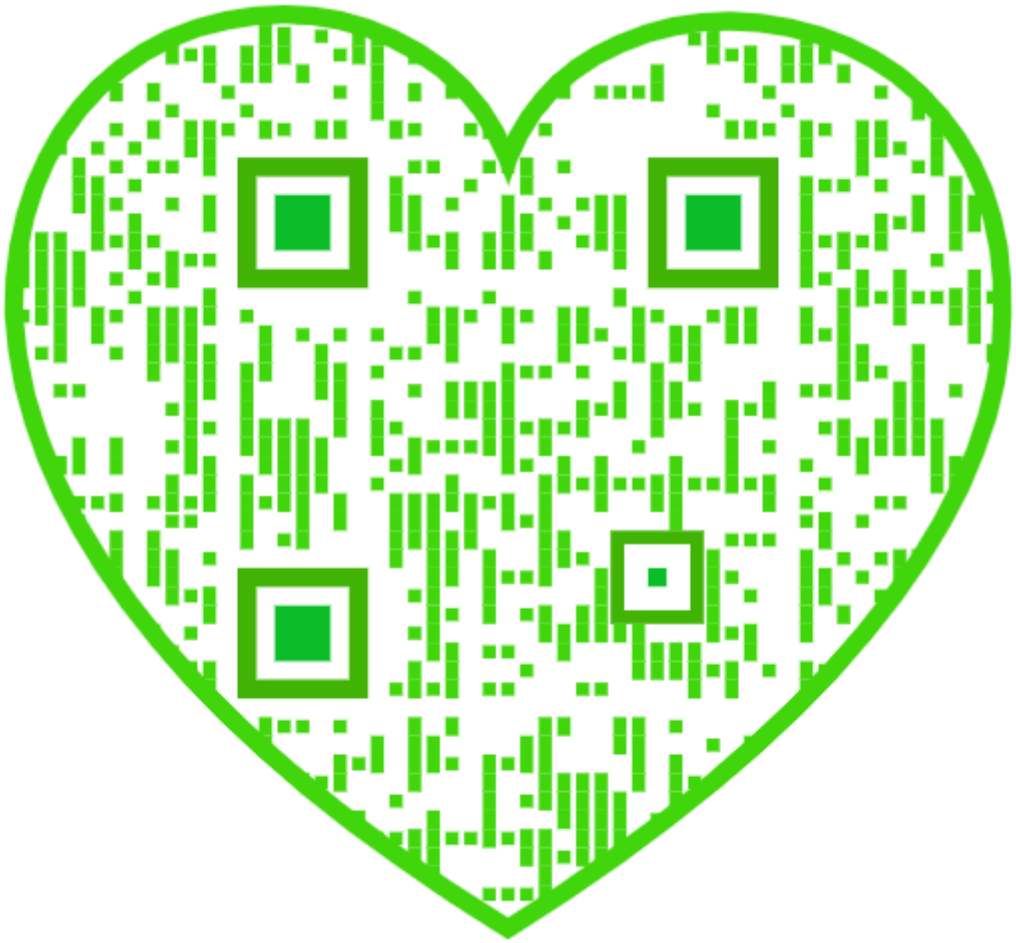

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NEW YORK, SATURDAY, MARCH 9, 1901.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE NEW STAR IN PERSEUS.

A sensation has been produced in the realm of stellar science by the recent discovery of a temporary star whose brightness exceeds that of any other object of that class which has been observed in the last three centuries. On February 21 Dr. T. D. Anderson, of Edinburgh, a well-known amateur astronomer, detected this celestial phenomenon in Perseus, a little south of Alpha and east of Beta in that constellation. Although the accounts regarding it are not altogether accordant, it would seem that at its maximum it exceeded Capella in brilliancy, and almost rivaled Sirius. And this culmination appears to have been reached on Sunday morning, February 24. Since that time the star has perceptibly diminished in splendor. During the early part of last week it was of about the first magnitude, and distinctly inferior to Capella, but brighter than its most conspicuous neighbors in Perseus, which are second magnitude stars. A little later even a novice could see that it had faded still farther. Upon receipt of news of the discovery the Harvard photographs of that region of the heavens made for a month previous were examined. The plate for February 19 showed the new star, but with a magnitude of less than 10.5. It also appeared on the plates of February 2, 6, 8, and 18.

It is necessary to go back to the famous outburst observed by Tycho Brahe in 1572 to find with certainty one which surpassed this in brightness. Tycho's star appeared in Cassiopeia, and is said to have equaled Venus at her best. Kepler saw another in 1604, but it is impossible to say whether it beat the new star in Perseus or not. Scarcely more than a dozen temporary stars have been reported since that time, and not one has matched the latest. Indeed, some of them have been invisible to the naked eye, or else, while bright enough to be seen without instruments, were detected only by the camera. The last discovery of a naked-eye temporary star occurred in January, 1892, and was made by the same Dr. Anderson who found "Nova Persei." It was in Auriga, only a short distance from the recent luminous outbreak, and not far from Cassiopeia, the site of Tycho's star. Pickering has called attention to the fact that nearly all of the fifteen stars which he enumerated appeared either in or near the Milky Way, a coincidence that he thought was not without significance.

Astronomers designate celestial developments of this kind "new stars;" but the phrase is misleading. Those who are versed in such matters do not imagine that these sudden appearances represent fresh creations, but suppose that something invisible before has become visible. But even so, the phenomenon presents a mystery of tremendous interest, both scientific and popular, and there has been much speculation as to its cause.

It has been suggested, for instance, that chemical combinations might occur in the atmosphere of an orb which had cooled down from incandescence to a barely luminous condition, and that these combinations would evolve enough heat to produce a vivid light for a short time. Zöllner conceived that a star with a thin crust over its molten mass might meet with an accident that would rupture the covering, and liberate an immense quantity of glowing material. Lockyer's notion has been that two vast swarms of meteoritic particles, flying in different directions, meet in space, and are made to glow by friction. Others have believed that two suns or stars, once hot and brilliant but since grown cold and dark, come into collision. Should such a thing happen the energy of motion would be converted into thermal energy, and the two bodies might be set on fire.

A theory somewhat akin to these last two was proposed by Wilsing a few years ago. Klinkerfues had previously tried to account for the flash of a certain class of variable stars on the hypothesis that the rotation of a satellite around its primary raised an immense tidal wave of obscuring atmosphere, sweeping it to one side and more fully revealing the partially hidden luminous surface below. Wilsing fitted this theory to temporary stars by supposing that some huge wanderer in space, like a dark sun, passed near enough to another body to produce similar effects, but on a larger scale. Seeliger has shown that tidal action could hardly last more than a few hours, but Scheiner remarks that it might serve as a trigger to liberate forces that would not exhaust themselves for a long time. The Klinkerfues-Wilsing theory commended itself more strongly than any of the others just mentioned to Sir William Huggins, the eminent English astronomer, although it has not been generally accepted.

A hypothesis advanced by Seeliger soon after the appearance of Nova Aurigæ has met with more favor, as it can be better reconciled with observed phenomena. According to this authority, only one solid body is concerned in the business, and this encounters a nebula. Now a nebula is supposed to be an exceedingly attenuated collection of matter, either gaseous or dust-like. Yet when one reflects on the almost inconceivable velocities at which the cloud and dark orb come together he can understand that a good deal of heat must be developed. The friction might be of short duration, and the effect on the invading body would not extend to any great depth, yet for the time being the result might be eminently pyrotechnic. The surface of the dead star would become incandescent, and possibly some of its material be vaporized. At the same time parts of the nebula would also be heated and caused to glow. Thus there would be two sources of light, though the latter would be temporary. There are strong reasons for suspecting that the recent outburst in Perseus represents an occurrence of this sort, and that the star and nebula will disappear from view after a few weeks or months.

The evidence on which this supposition is based is supplied by the spectroscope. That instrument showed conclusively that in Nova Aurigæ at least two objects were concerned, because there were two different spectra, one superposed on the other. There was the characteristic spectrum of a nebula, and the spectrum of an incandescent solid over which some incandescent metallic vapors floated. The same state of things was also indicated, but less distinctly, in the case of the temporary stars in the Northern Crown (1866) and the Swan (1876). And already the same combination has been imperfectly revealed in the observations of Nova Persei. Incidentally, it may be remarked that the nebular spectrum of the star in Nova Aurigæ lasted much longer than the stellar spectrum, and that when last observed with a telescope it presented the appearance of a ball-like nebula.

The spectroscope betrays motion as well as composition. And Campbell estimated that the two objects involved in the production of Nova Aurigæ moved toward each other at the rate of 550 miles a second! Lockyer is said to have put the combined motion in the new star in Perseus at 700 miles a second. Possibly this is an over-estimate, because Campbell reports that relatively to the solar system the star seems to be nearly stationary.

As yet the distance of Nova Persei from us cannot be guessed. It may be fifty light years away, and it may be a thousand. It has been in existence too short a time for any parallax work to be done with it. But the chief matter of interest is the nature of the event which the object reveals, and not the precise location of the scene.

AN IMPORTANT TELEPHONE PATENT DECISION.

The United States Circuit Court for the District of Massachusetts has just handed down a decision in the suits of the American Bell Telephone Company against the National Telephone Manufacturing Company, and the American Bell Telephone Company against the Century Telephone Company, for infringement of the famous Berliner patent, No. 463,569, dated November 17, 1891, for microphone attachment for telephones.

A few remarks concerning this patent, and its history and litigation, may be of interest at this time.

As is well known, the transmission of speech by telephony requires two instruments, the first, the transmitter, into which the speaker talks, and the second, the receiver, at which the hearer listens. Mr. Bell's patent of 1876 described an instrument which could be used interchangeably for either of these purposes. In 1878 Mr. Edison and Mr. Blake produced transmitters, both unlike Mr. Bell's, and differing from each other in detail, but operating on the same general principle. They both belonged to the class of transmitters called microphones, the distinguishing feature of which is that the undulations of the electrical current by means of which the sonorous vibrations of the air in the transmitter are caused to be reproduced in the receiver, are caused by variations of pressure between two electrodes remaining constantly in contact, which variations of pressure are caused by the vibrations of the diaphragm of the transmitter.

The Bell company acquired title to both these patents, and enjoyed the exclusive right to the use of said inventions during the life of the respective patents.

About the time that the patent on the Blake transmitter was expiring, the public were astonished to learn that a patent had just been issued to the Bell company, covering in the broadest possible terms the identical microphone transmitter for which the telephone subscribers had been paying rentals in the past, and under which new patent the Bell company would be entitled to exact a continuance of the same rentals for the same instrument for seventeen years longer.

An examination of the files in the Patent Office, then for the first time accessible to the public, showed that the application for this new patent had been filed by Emile Berliner, June 4, 1877, and had become the property of the Bell company in 1878, and had been controlled by that company to the time of its issue.

The extraordinary delay in the issue of the patent (the application being all the time under the control of the Bell company), coupled with the manifest interest of that company to prolong its monopoly by means of that delay, prompted the United States, in 1893, to bring suit against the Bell company and Berliner to set aside and cancel the said Berliner patent. On January 3, 1895, the United States Circuit Court entered a decree setting aside and canceling said patent. On appeal to the United States Circuit Court of Appeals for the First Circuit, that court, on May 18, 1895, reversed the decree below, and directed a dismissal of the bill of complaint. Thereupon, the United States took an appeal to the United States Supreme Court, and on May 10, 1897, that court rendered a decision affirming the decision of the United States Circuit Court of Appeals.

The suits just decided by the Circuit Court were brought to enjoin the defendants from making, using, or selling telephones embracing or containing a microphone attachment substantially as claimed in the said Berliner patent. The court, on the 27th inst., dismissed the bill of complaint, holding the Berliner patent to be void, and anticipated by the Edison and Bell inventions.

The Bell company will undoubtedly take an appeal, and the public will await with interest the ultimate decision which will confirm or destroy the Bell company's monopoly.

THE SLABY SYSTEM OF WIRELESS DUPLEX TELEGRAPHY.

From an ill-understood curiosity wireless telegraphy seems at last to have become an important and valuable branch of electrical science. Much of the credit for this evolution is due to Prof. Slaby, of Charlottenburg, and to his indefatigable collaborator, Count Arco, both of whom have systematically investigated the phenomena of the Hertzian waves and formulated laws by which these phenomena can be explained. As a result of their labors, the uncertainty and whimsicality of wireless telegraphy have disappeared. Much that was formerly considered indispensable in the ethereal transmission of electrical waves has been proven unnecessary, and even disadvantageous.

The balloon at the upper end of the transmitting wire, supposed to serve the purpose of increasing the capacity; the peculiar plates at the receiving station, formed like butterfly-wings, and likewise designed to increase the capacity; the careful insulation of the receiving wire from the earth; and other details of the old system have been rudely thrown aside. Nothing more is heard of the law that the distance to which messages can be transmitted is proportional to the square of the length of the transmitting and receiving wires. That there is a definite relation between distance and length of wire or height of mast may well be assumed; but that relation, whatever it may be, plays no very important part in Slaby's system, since the tension to which the coherer is subjected is augmented by means different from those hitherto known.

The waves sent forth by a transmitter loop are augmented by a condenser. An induction coil is connected with the upper end of the loop, and is so wound that it permits the passage of low-frequency currents, but checks the high frequency currents generated by the discharge of the condenser. At the moment of discharge the loop acts as a single vertical wire. By varying the nature of the induction-coil and the condenser, waves of any length can be sent forth. At a lecture delivered before the German Emperor, waves varying in length from 140 to 600 meters were utilized.

In direct opposition to Marconi, Slaby grounds his receiving-wire. An ordinary lightning rod is used instead of a mast. If the length of the receiving wire be exactly one-fourth the wave length, a node is formed at the connecting-point with the earth, and the maximum amplitude of the alternating tension appears at the upper end. Evidently the coherer should be attached to the point of greatest amplitude; but such an arrangement is impossible in practice. The difficulty is very simply and ingeniously overcome by connecting with the receiving-wire at the earth-node

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a horizontal auxiliary wire of equal length. At the free end of this horizontal wire the wave-amplitude is equal to that of the upper end of the main wire. To the free end of this auxiliary wire the coherer is attached. The auxiliary wire need not be extended in a straight line; it can be wound to form a coil.

If the main receiving-wire, which is usually a lightning-rod, and which cannot, therefore, be readily lengthened and shortened, be subjected to the action of electrical waves of greater length than the wire can receive, it is necessary merely to lengthen the auxiliary wire in order to receive the message. In this manner a nodal point can be formed in the auxiliary wire, so that the receiving-wire may be subjected to electrical impulses by which it would not otherwise be influenced. The auxiliary wire in Slaby's system is of the utmost importance; for by its use the receiving apparatus will be affected only by certain waves. Thus Prof. Slaby has succeeded in overcoming one of the most glaring deficiencies in wireless telegraphy—the impossibility of secretly transmitting a message to one station alone.

In order to increase the effect of the waves, a peculiarly wound induction coil is placed in the circuit between the coherer and the auxiliary wire. The coil Prof. Slaby terms a "multiplier." By means of this instrument a trustworthiness and certainty of operation have been attained which are as gratifying as they have been conspicuously lacking in previous methods of ethereal telegraphy.

Not the least interesting feature of Prof. Slaby's invention is the possibility of receiving two messages simultaneously at a single station—an end which has been attained largely by means of the auxiliary wire of variable length already mentioned.

A TRIUMPH OF INGENUITY AND A PATENT WITH A HISTORY.

When we consider the inventions of the latter end of the Nineteenth Century we are sometimes impressed by the enormous amount of inventive skill which is required to put all the parts of a complicated mechanism into that juxtaposition which enables them to perform properly their delicate offices in harmony. Many inventive minds capable of conceiving great ideas in their generalities are lacking in that knowledge of mechanical minutiæ which alone would qualify them for putting their ideas into practice. When a person combines these two qualities the full triumph of inventive genius may then be attained. One of the most remarkable examples of the union of large ideas and broad principles underlying a complicated train of mechanical operations, together with a most elaborate working out of movements and details, is exhibited by the Paige typesetting machine, invented by James William Paige, of Hartford, Conn., now of Chicago. The machine, which sets, justifies and distributes foundry types with wonderful speed and precision, is probably the most complicated piece of mechanism ever devised, and it is gratifying to know that the present owners of the patent have presented it to Cornell University, where it will, for all time, remain as a monument to the painstaking care of an inventor who spent seventeen years of his life perfecting it. The machine as it stands has 18,000 active elements, including 800 journal bearings. While the work produced was of the first grade and the machine was successfully operated by The Chicago Herald, the cost and complexity rendered it impossible for use on a commercial basis, machines costing one-seventh or one-eighth as much performing work which was entirely satisfactory and without any of the risks of a breakdown which would be always present in a machine having 18,000 parts. The machine is described in detail elsewhere. It will be interesting to trace the history of an invention and a patent which for size and complexity is the most celebrated upon record.

There are three patents which were issued simultaneously on October 15, 1895. The first patent had 31 sheets of drawings, 28 pages of specification, and 130 claims; the second patent had 163 sheets of drawings, 46 pages of specification, and 146 claims; the third patent, of which Mr. Charles R. North, of Chicago, was joint inventor with Mr. Paige, had 81 sheets of drawings, 49 sheets of specification, and 172 claims, and referred particularly to the justification of the type. This made a grand total for the three patents of 275 sheets of drawings, 123 sheets of specification, and 613 claims. The largest patent, No. 547,860, is really a volume in itself, and the drawings are very handsome and include in the 163 sheets 471 figures and 1,075 figures of reference.

The application was filed August 19, 1887, with the customary government fee of $15. The file was signed for allowance by James Q. Rice, examiner, on March 22, 1895. The notice of allowance was dated March 26, 1895, and the final fee of $20 was paid September 23, 1895, and the patent issued in due course on October 15. The first official letter was dated on March 15, 1888, or about seven months after the case was filed. The second official letter was more than two years later, on May 5, 1890; other official letters were dated April 14, 1891, and July 18, 1894. The long waits between the official letters show the enormous amount of work which had to be done by both the attorneys and the Patent Office before the various actions were taken. Mr. Giles S. Rafter did practically all the work of examination of the application in the Patent Office, and we are indebted to him for much of our information. The patent attorney and the draughtsman went to Hartford, where Mr. Paige was then living, and where he had his machine, and prepared the application. It is said that the attorney's fee was $10,000 for the patent to which we refer, and the draughtsman received $2,000 for his services. The application as presented included 204 sheets of drawings, but during the course of the application through the Patent Office the number of sheets were cut down by eliminating all the illustrations that were deemed unnecessary. This was done with a view to save as far as possible the expense of issuing the patent. Mr. Paige changed attorneys and the whole case was rewritten. Subsequently Mr. Paige removed to Chicago and established a factory for manufacturing the machines. His new attorney in turn rewrote the case, and the patent as issued is the result of his labors. There is something tragical about this case, for one of the examiners who worked upon it and who signed the first official letter in 1888 died in 1890 or 1891, and the patent attorney who originally prepared the papers died insane, and Mr. Charles H. Richardson, who was acting examiner, and who signed the third official letter, also died insane, but as he had little to do with handling the case it is not thought that the application was responsible for his misfortune.

When the Patent Office considered the application for the large patent, it was suggested on behalf of Mr. Paige that the assistant examiner go to Chicago and examine the application in connection with the machine. The Paige people were notified that they would either have to bring the machine to Washington or pay the examiner's expenses to go to Chicago to examine the machine, and as it would have cost from $6,000 to $7,000 to bring the machine to Washington they naturally preferred to pay the assistant examiner's expenses. The then Commissioner of Patents, Seymour, peremptorily refused under a rule to permit the examiner to go, but the examiner suggested that this was an extraordinary case and asked permission of the Commissioner to bring the case to his room for inspection. This was done, and the papers and drawings were about all that the man could carry, and the Commissioner consented to send Mr. Rafter to Chicago. The latter spent five or six weeks in Chicago, being engaged part of the time in the attorney's office and part of the time in the factory examining the machine. The machine as originally built was 18 or 20 inches too long, and while Mr. Rafter was in Chicago Mr. Paige had a large corps of draughtsmen with a chief draughtsman at $10,000 per annum, and four assistant draughtsmen engaged in reorganizing the machine to reduce its length, as desired. They had a large vault in which the working drawings were kept, and it is estimated that it contained about 10,000 sheets, 3 by 3 feet, of working drawings of the machine in hand. At that time they had in the factory one complete machine, and one machine in course of construction. The former was kept behind a dozen locked doors. Mr. North, the joint inventor, was a skilled mechanic, and was one of Mr. Paige's workmen who had been helping him in developing the justifying apparatus. The government was naturally put to very heavy expense besides the actual expenses of examining the case. It is estimated that it consumed about $1,000 of time of the various Patent Office officials before maturing into a patent, and when issued the usual rule had to be followed of providing copies for sale at the regular price. As the text was about $2.60 a page and 93 cents a page to reproduce the drawings, this, combined with the cost of paper and printing, made the cost of the first edition over $6 a copy. The larger patent is as big as a good-sized book, and the three together make an imposing volume.

A NEW PERMANENT PHONOGRAPH RECORD.

When the phonograph first made its appearance, in 1878, it took a remarkably strong hold on the imagination both of scientific men and of the general public. It was prophesied at the time that public speeches would be dictated and reproduced before audiences in any part of the country; letters would be spoken instead of written, and reuttered in the accents of the sender's own voice; and, greatest of all perhaps, the voices of great singers and noted men would be preserved for the instruction and delight of future generations.

Up to the present time, the instrument has been put to these uses to a very limited extent, to the last one scarcely at all. The wax records ordinarily used are not adapted to the purpose, because they are not sufficiently durable. They are frail and easily defaced, and gradually wear out after being used a few times. There are now, however, two or three satisfactory ways in which phonographic records can be preserved indefinitely, the most interesting of which, perhaps, is described in a recent patent of Mr. Edison's. From an ordinary wax record he produces a very perfect duplicate made of silver with a thin plating of gold. There seems to be no reason why such records will not last for centuries, and a collection of them, preserved perhaps by our museums and learned institutions, should be of the highest value to the future student of history, language and music, more especially as it is possible, by processes already well known, to obtain from them at any time an almost indefinite number of excellent copies.

The reproduction of the voice given by the phonograph is still somewhat disappointing, and leaves much to be desired as a means of studying language; but there can be no doubt that if we had a collection of records made, say, in the age of Elizabeth, and as perfect as those now produced, we would learn much of the speech of the sixteenth century.

Mr. Edison's process is simple but interesting. He takes a copper electroplate of a wax record. This copper relief obtained is then electroplated with silver, the surface of which, next the copper, of course has precisely the form of the original wax surface. The copper matrix is then dissolved away with acid.

In the electroplating process the wax record is revolved under a bell-jar, in a Crookes vacuum, through which an electric discharge is passing between electrodes of gold. This causes a discharge of a vapor or infinitesimal particles of gold, which attach themselves to whatever they strike, forming a continuous coating of excessive thinness, and following the outline of the surface with absolute fidelity. Upon this coating the copper matrix is plated, to form the inside surface upon which the silver is deposited when the wax is removed.

The gold, like the silver, being unaffected by the acid used, remains as a plating on the silver record when the copper matrix is dissolved away. The amount of gold used is scarcely appreciable, and the silver may, of course, be a thin shell, backed up by other material, so that the records are not as expensive as might be supposed from the materials employed.

THE POLLOK MEMORIAL PRIZE.

From time to time we have called the attention of inventors to a prize of 100,000 francs ($20,000), to be known as the Anthony Pollok Prize, offered by the heirs of the late Anthony Pollok, of Washington, who lost his life in the fatal collision of the steamship "La Bourgogne" with the "Cromartyshire," off Sable Island, nearly three years ago. The prize, it will be remembered, is to be awarded to the inventor of the best device for fulfilling one or all of these conditions, to wit: To prevent collision at sea, to save the ship in case of collision, to save the passengers and crew collectively in case the ship is abandoned.

Previous experience has shown that many devices and apparatus offered could not be practically relied on in case of accident, owing to the limited number of the crews of merchant vessels. It has therefore been decided to exclude devices designed to save individuals separately, such as life belts, waistcoats, buoys, etc.; such apparatus which encumber the decks so as seriously to interfere with the carrying capacity both as to passengers and freight, or such as could not be readily adapted and used on ships now in general service; all improvements or modifications of inventions already recognized as insufficient for the purpose of saving the passengers and crew collectively, such as lifeboat davits, oil-throwing devices, etc.; rafts of all kinds which must be mounted, assembled or inflated at the time of the accident; and hatch covers, deck houses, etc., which are designed to float automatically when the ship sinks.

The devices and inventions may be presented in full size ready for trials, or models and drawings showing all details may be submitted.

The competition will be opened at Havre on September 9, 1901.

The jury, whose names will be published later, will consist of men whose competency is unquestionable and will have power to prescribe tests and trials. All possible facilities will be offered to the inventor; but all expense must be borne by him. The exposition of devices entered in the competition will be held at Havre under the auspices of the Chamber of Commerce of that city. No charge will be made for space, or for the care of the exhibits. If the exhibit be marked "Prix Anthony Pollok" no duty will be exacted by the French customs officials.

The devices must be delivered free of charge at Havre between August 1 and September 1, 1901, and addressed "Concours Prix Anthony Pollok. Capitaine S. Dechaille, Directeur du Service des Signaux et du Sauvetage de la Chambre de Commerce, Havre, France."

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AN IMPROVED GASOLINE AUTOMOBILE.

The vehicle shown in our illustration has recently been severely tested over a run of 538 miles, without a rest, during extremely cold weather, almost unendurable by the drivers.

It is a new Columbia gasoline runabout, known as Mark 8, built by the Electric Vehicle Company, of Hartford, Conn., after plans by Mr. Hiram P. Maxim, chief engineer of the company, and has demonstrated satisfactorily its durability and power in the test lately made. The total weight of the vehicle, with eleven gallons of gasoline and sundries, is 1,640 pounds. The quantity of gasoline mentioned will carry the vehicle 165 miles.

The engine is a single cylinder, Otto cycle. The cylinder dimensions are 4.6 diameter by 6.8 stroke. The complete engine, with 19-inch flywheel, weighs 240 pounds. This weight includes governor, carbureter with piping, water-cooling pump and necessary piping therefor. The engine is of the single-cylinder type having 5 brake horse power actual at 750 revolutions per minute. It is located in the front of the vehicle, as in the standard designs, as found best by long experience in Europe. It is mounted upon a separate spring-supported frame of its own.

Power is transmitted from the engine flywheel through a friction clutch operated by a pedal in the floor, also as in best European practice. From the friction clutch a shaft runs longitudinal of the vehicle, and carries four gears, three of them being for different gear reductions ahead, and one for reverse. The countershaft, to which they gear, continues to the rear axle, which is "live," and which it drives through the medium of very large and generously proportioned bevel driving gears. The entire gearing is incased in one cast-steel box, which includes the rear axle, and which positively insures the alignment of everything. That this construction is carefully worked out may be judged by the fact that at 4 horse power input at the friction clutch, the losses in transmission to the rear axle are only 6 per cent.

The gear reductions are respectively 15.2 to 1, 7.8 to 1, and 4 to 1, with 13.9 to 1 for reverse. These gears are thrown in by positive clutches, which are operated in a very simple manner by one lever projecting up at the side of the seat. The principle of control is much simplified, all the change gear functions being done by one lever. In order to insure positively against attempting to throw in changes of gear without disconnecting the engine or source of power, a very simple and ingenious interlock is provided, which makes it impossible to change the gear without first pressing forward the clutch pedal which disengages the friction clutch on the engine flywheel.

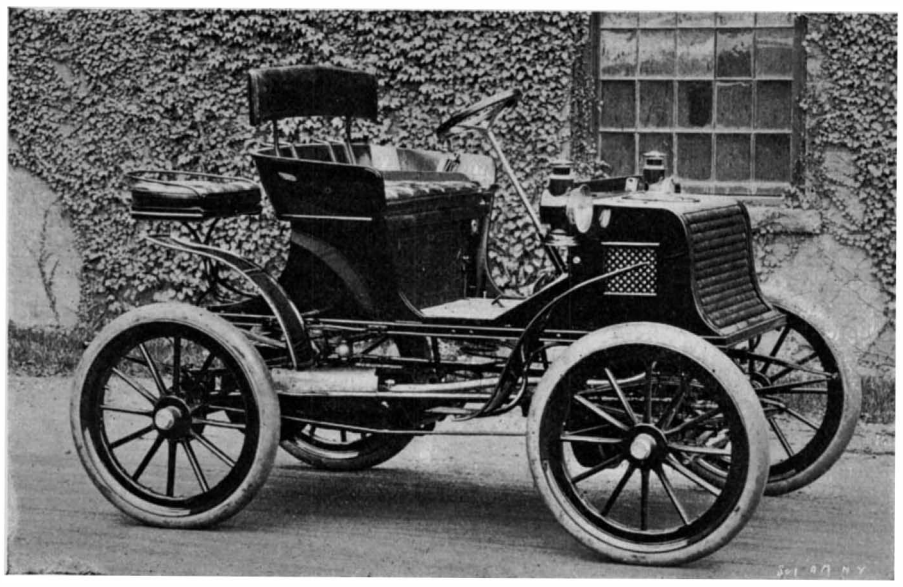
The friction clutch is a plain wind-up brake faced with leather, so that all degrees of slipping can take place without danger of cutting or running dry, insuring wearing nothing more than a leather band. This is of ample proportions so as to prolong the life before the new leather has to be put in.

The speed of the engine is controlled by a governor. This governor operates a valve in the suction pipe. In the suction pipe beyond the governor throttle is the aspirating carbureter, so arranged that when the governor throttle opens and permits a vigorous suction a larger amount of gasoline aspirates, or when the governor throttle, by partially closing the suction pipe, reduces the vigor of the engine suction, less gasoline is aspirated. This insures a uniform quantity of gas mixture at all engine speeds.

The engine is speeded beyond its normal by means of a foot pedal control, and the ignition is automatically advanced or retarded by the engine according to its speed, so that the maximum effect is always produced from whatever charge the governor permits the engine to get. The ignition is by the secondary current and jump spark. The primary current was generated from four cells of a special dry battery.

In the recent 500-mile run, when the climatic and road conditions were as severe as they are ever likely to be in this latitude, it was found that 14.4 miles were obtained per gallon of gasoline, the load being 2,040 pounds, including the weight of two passengers, heavy wraps and baggage.

The best average speed on this trip was 23 miles per hour, made on the west side of the Connecticut River, between Hartford, Conn., and Springfield, Mass., over roads that were a succession of grades.

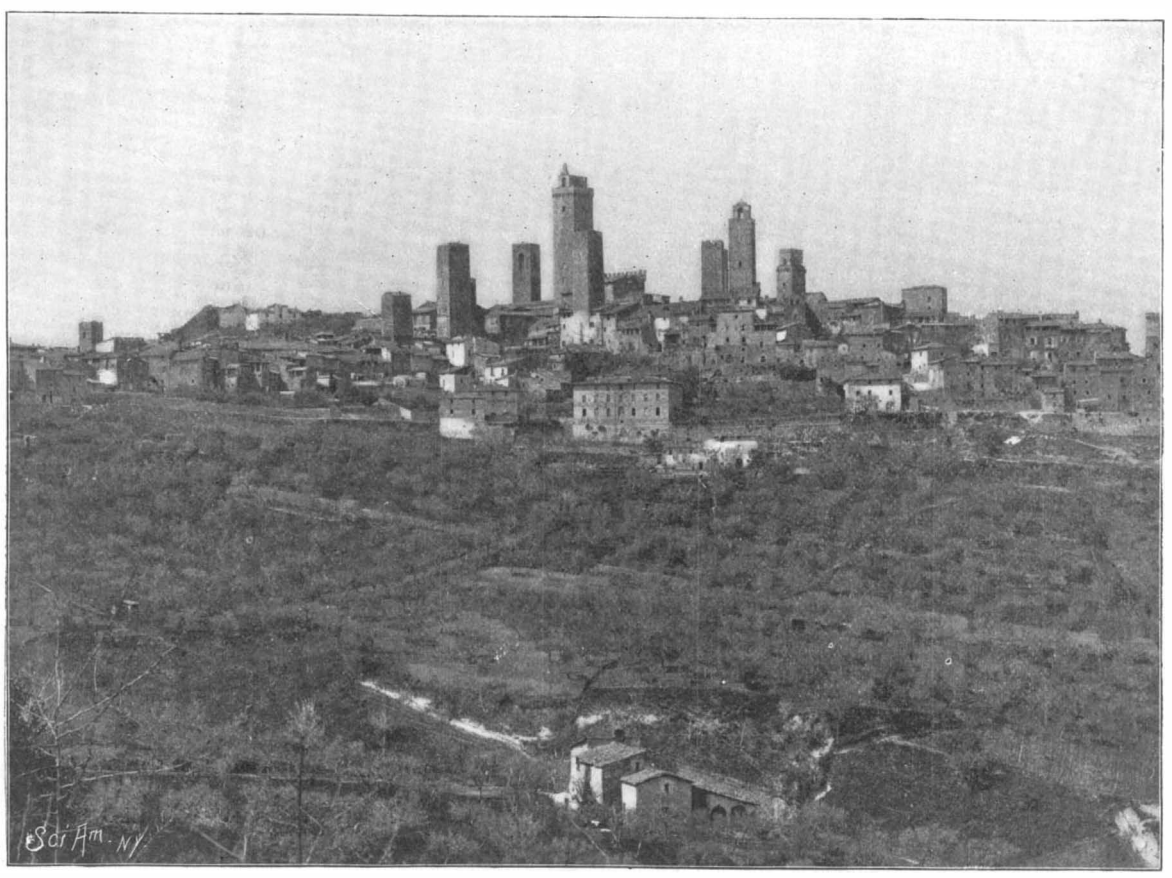


A NEW COLUMBIA GASOLINE RUNABOUT.

The vehicle ran continuously for forty-one hours, with but one stop of fifteen seconds. The trip was up one side of the Connecticut River from Hartford, Conn., and back on the opposite side, over roads nearest to and parallel with the river. Altogether, it was quite a successful trial, and proved the capabilities and economy of this type of vehicle perfectly.

SAN GIMIGNANO AND ITS TOWERS.

Massimo d'Azeglio has well said that San Gimignano is the Pompeii of the middle ages. It lies on the railway between Florence and Siena, and is beautifully situated on a hill. Like most of the cities of the Latin peninsula, it had its origin in Roman times, and in the tenth century we begin to hear of the sturdy little city, and a century or two later it was really an independent state of ten thousand inhabitants. The year 1276 marks the apogee of its political life, and the city, as we see it to-day, dates largely from this time; but in 1353 it suffered terribly in consequence of the dissensions of the leading families who belonged to the opposite political parties, and at last it became subject to Florence.



THE TOWERS OF SAN GIMIGNANO, ITALY.

There is no town in Tuscany which presents so faithful a picture of Dante's time, and nowhere can we obtain a clearer insight into the rich development of Italian art in the earlier years of the period which preceded the Renaissance. The tranquil architecture of the thirteenth century has not lost its freshness, and the multiplicity of the noble edifices and an air of sumptuousness on a small scale all aid in making it a delightful spot to visit. It is truly what the French call a "strong place," with its crenelated walls and towers. The towers make the city look like some Eastern town with lofty minarets, and their effect is most striking. There were originally fifty towers, but now only thirteen remain, so that the reader can imagine what it must have looked like in the middle ages. These towers were built for defense by various families during the turbulent times when Guelphs and Ghibellines fought each other gratuitously. Adjoining the Palace is the Torre del Comune, 331 feet high. It had a mark part way to indicate the height beyond which the citizens were not allowed to build, according to a sumptuary law. The city, which now has 8,200 inhabitants, is a charming one to visit, although tourists seldom make stops there. New York, with its high buildings, really resembles San Gimignano at certain times in the twilight or in a light fog, and the skyline is most picturesque in both instances.

Experiments on Transmission of Malaria by Mosquitoes.

A few months ago Drs. L. Sambon and G. C. Low, of the Tropical Medical Institute of London, decided to establish themselves in the Roman Campagna, near Ostia, for the purpose of studying the question of the propagation of malaria by mosquitoes. The malarial season lasts from May to the end of October, and it was during this period that the experiments were carried out. In this region no one can remain even for one night without the risk of contracting malarial fever of a very violent type. The doctors took no medicine of any kind, but simply adopted the precaution of retiring every night, one hour before sunset, to a specially constructed hut, in which it was impossible for the mosquitoes to enter; and they did not come out before one hour after sunrise. In this way they entirely escaped being bitten by the mosquitoes, which, as is well known, only seek their food at night. The British Medical Journal states that the experiment has furnished conclusive results as to the propagation of malaria by mosquitoes. On the 13th of September, Prof. Grassi, accompanied by a number of scientific men, visited the two English physicians, and found that they were able to exist in perfect health in the midst of a population decimated by malaria. They showed, therefore, that it is only necessary to avoid being bitten in order to escape contagion. The experiment, however, being of a purely negative character, it was desired to make further proof and show that the malaria would be produced in a perfectly healthy person, if bitten by mosquitoes containing the germs of the malady. This idea was also carried out. A collection of mosquitoes, which had been in contact with malarial patients at Rome, was prepared by Prof. Bastianelli, and sent to Dr. Manson at London. One of the sons of the latter offered himself as subject of experiment. Although he had never, since his infancy, been in a malarial country, he became infected and thus furnishes a striking proof of the transmission of malaria by mosquito bites.

Prof. R. T. Fessenden, of the United States Weather Bureau, is making experiments with wireless telegraphy on the southern coast. Stations will be established at Capes Hatteras and Henry and at other coast points north of Cape Hatteras. It is the government's intention to communicate storm warnings to vessels at sea off this dangerous locality. It is also intended to send storm signals to life-saving stations when the wires are disabled. If the tests are successful, the entire coast will be similarly equipped.

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TREES AND PLANTS OF SOUTHERN CALIFORNIA.

BY PROF. CHARLES F. HOLDER.

The cacti of Southern California are equally striking. Here all the choice hothouse specimens of the East are seen out-of-doors, standing the occasional cold winter nights without perceptible effect, and giving the impression that the cold is not so severe as it seems. In Fig. 1 a California cacti garden is shown, similar to several in Pasadena, Coronado, and Los Angeles. Here is the huge candle cactus so common on the Mexican and Arizonian deserts, and many more affecting curious and grotesque shapes; but the common cactus of the country is the *Opuntia*, or prickly pear (Fig. 2), of which there are one hundred and fifty species. One large form, called the tuna, may be seen growing effectively near San Gabriel. The leaves are enormous, and the plant is sixteen or seventeen feet in height. This cactus was planted as a hedge around the old mission of San Gabriel, described by the writer in a previous number of the SCIENTIFIC AMERICAN. The cacti are not beautiful in themselves, but they add to the attractions of the landscape, and in many localities on the mainland and on the islands off shore there are veritable forests of cactus, which in the spring are a mass of yellow bloom. The fruit of the purple prickly pear is sometimes eaten; it makes very fair wine and jelly, and has various economic values. The interesting feature of the cacti lies in their blossoms, which are often remarkable in color, perfume, and shape. Of all the family the Rainbow Cactus—*Candicans*—is most striking, each plant bearing eight or nine blossoms, four or five inches across—a veritable blaze of color. *Dasyacanthus*, covered with gray spines, a hideous object, has a splendid large flower, red and vivid yellow. *Pectinatus* has large pink blossoms four inches across.

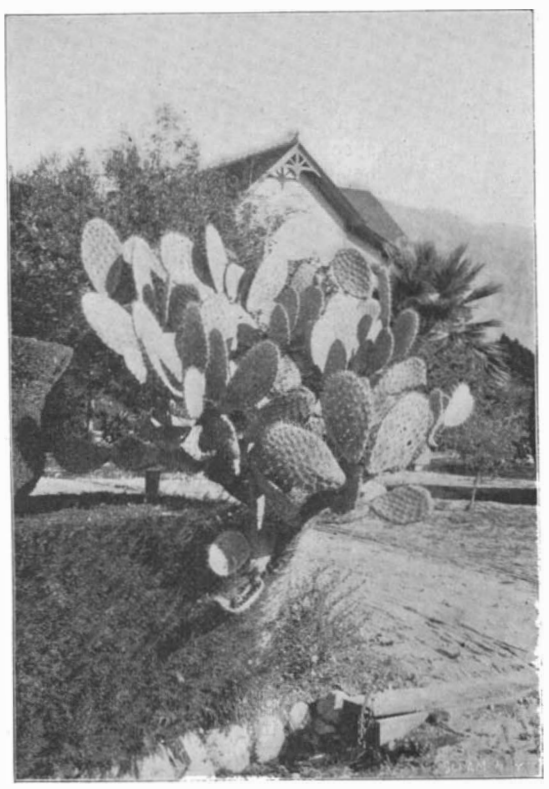

Fig. 2.—PRICKLY PEAR, OPUNTIA.

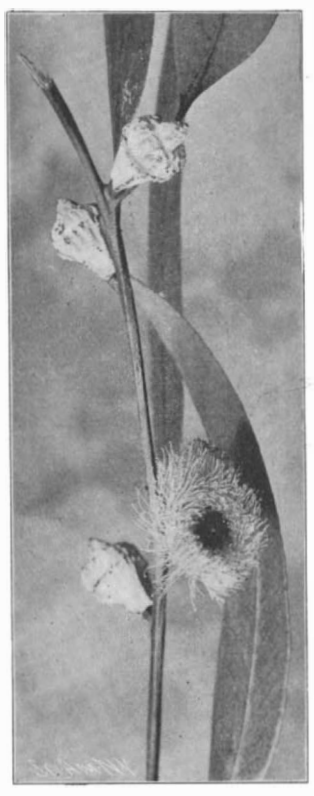

Fig. 3.—EUCALYPTUS BLOSSOM.

Fig. 4.—PEPPER TREE.

Australia has contributed to the adornment of Southern California mesas. Fifty years ago the table lands were either barren, or had here and there groves of live oaks; but now valleys like the San Gabriel appear dotted with forests in geometrical lines and squares. These trees, tall, plume-like and of showy mien, are eucalypti from Australia, among the most valuable importations, as they are very rapid growers, and when cut grow again from the stump; when large they are magnificent specimens of trees. These trees are employed to line avenues, to form windbreaks; they produce oil and kino, and are extremely valuable in reclaiming waste or damp places. The eucalyptus was introduced into California by the Hon. Ellwood Cooper, of Santa Barbara; and many of the one hundred and fifty species are to be found in the State to-day. The blue gum, the common form of Los Angeles, Pasadena, and other places, is one of the tallest of trees, and some noble specimens are known. One in Tasmania has been measured and found to be three hundred and thirty feet tall; and it is claimed that four hundred feet has been attained. From the seed the eucalyptus will attain twenty-five feet in eighteen months. An eight-year-old tree at Kinneloa, near Pasadena, measured seventy-one feet in height. In Fig. 3 the eucalyptus blossom is seen. It represents the famous Magnolia Drive at Riverside, with eucalyptus trees in the center and upon the left. The tree which possibly attracts more attention in California than any other is the pepper (Fig. 4), with its beautiful lacelike mass of foliage and clusters of vivid red berries. The pepper makes an effective shade, and is the characteristic tree of Pasadena, Los Angeles, and Riverside.

Marengo Avenue, in Pasadena, is particularly noted for its interlocking pepper trees, which, growing on either side, meet, forming a perfect arch for a mile or so. The tree is a rapid grower, and under favorable conditions attains a large size. This pepper is the *Schinus molle* of botanists, and was probably brought to California from South America. A pleasant fiction, which is sometimes explained to tourists, is that it is the tree from which pepper comes; but it is needless to say that the name arises from the pungent, peppery odor of the red berries or drupes.

The enigma of the Californian climate is still further emphasized by the banana, which is seen in many sections. It attains large size and beauty, especially the Abyssinian varieties; but they do not come to perfect fruition. The guava, tamarind, orange, lemon, lime, grape fruit, loquat, alligator pear and a score of others grow here, illustrating the possibility of tropical vegetation in a semi-tropic climate.

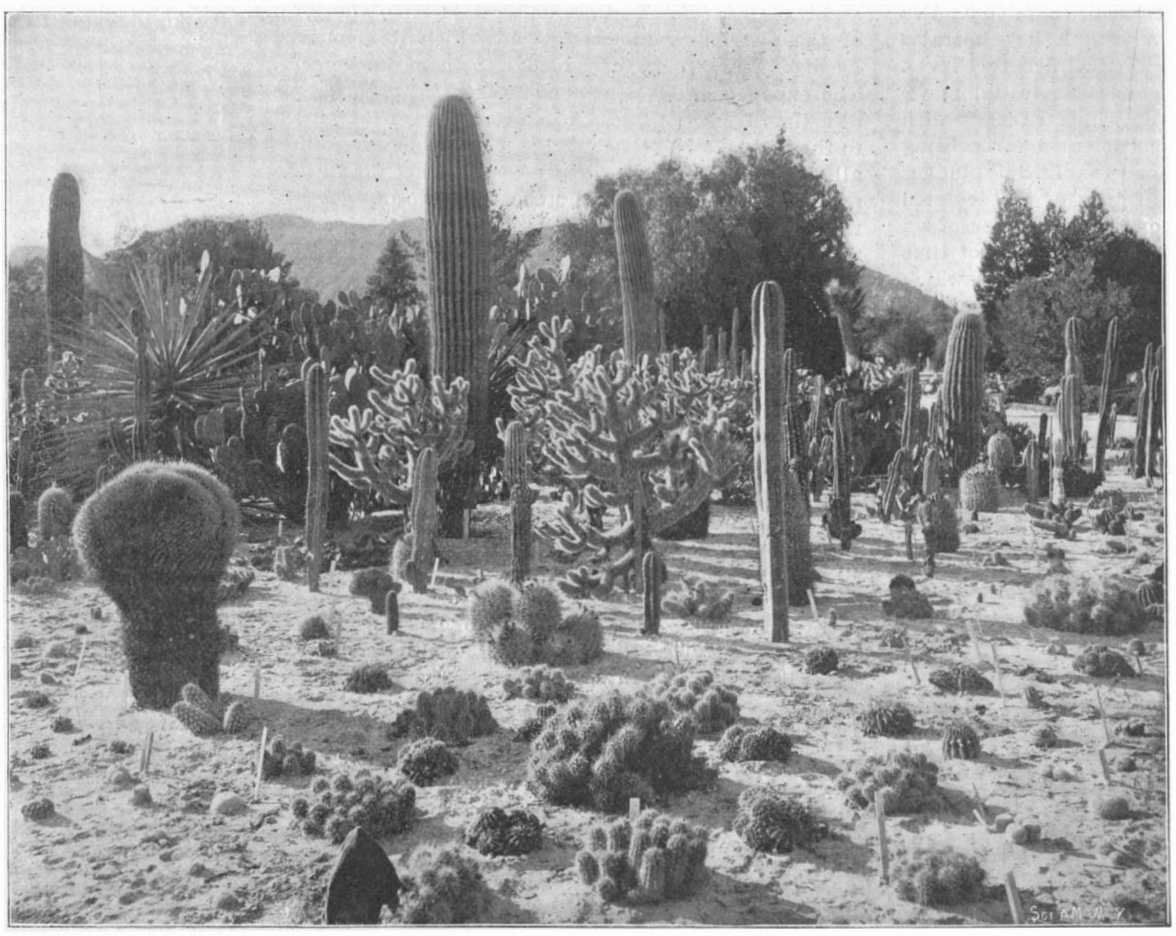

Fig. 1.—CALIFORNIAN CACTI GARDEN.

Change of Color Observed in Shrimp.

Two English scientists, Messrs. Gamble and Keeble, have lately published an account of the change of color produced in the case of a variety of shrimp, known as the *Hippolyte varians*, which lives among the seaweed along the borders of the coast. It has been already observed that some of the shrimps change their color according to the locality in which they live. The authors have made a careful study of the subject, and have prepared a series of colored plates which show the different colors of the shrimp and the seaweed; thus on brown seaweed a brownish color is assumed, often streaked with small lines which imitate in a striking manner the structure of the plant. On the zosteres a green color is taken, and in each case the coincidence of color is well marked. The authors find that if a shrimp which has adapted itself to a certain color is transferred to another, the corresponding color-change is not immediate; if, for example, the shrimp adapted to green seaweed is changed to brown, it keeps its original green color for more than a week, and at the end of that time only some of the individuals have changed their color to brown. Thus, although the color of the substratum acts upon the animal the change is slow and uncertain, which shows that the individuals which are adapted to a certain type of plant must have lived upon this from an early age and could hardly change their locality without danger. The color of the hippolyte is modified rapidly and surely when the light is made to change in intensity, but at equal intensities monochromatic light seems to have no influence upon them. Another point observed by the authors is that the hippolyte, and probably other crustaceans such as the mysis and pandalus, give singular periodic changes of color. At 9 o'clock in summer and 5 o'clock in winter the diurnal tint changes little by little and in about one hour arrives at an intense azure blue, accompanied by an almost entire transparence of the body. It seems that the hippolyte has acquired the habit of this change, for if it is kept continuously for 24 or 48 hours in either a dim or a lighted aquarium, it none the less assumes the dark color when night approaches outside. The experiments made as to the effect of a longer time have not yet been fully realized, but the present facts remain unchanged. The movements of the chromatophores are without doubt directed by the nervous system, as has been shown, among others, by Pouchet. When the light changes in quality or intensity the starting point of the action seems to be the optical center, but the periodic change of color has its origin, not in the eyes or the optical ganglia, but in the rest of the nervous system.

It is proposed to illuminate the Yosemite Falls, 2,600 feet in height, by the use of twenty arc lights in connection with means for producing color effects. Some of the roads are also to be lighted with electricity.

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THE PAIGE TYPESETTING MACHINE.

Mr. Paige first had his attention directed to the typesetting problem about 1873, and in the next year he completed a composing machine which contained no provision for justification or distribution. He then invented and constructed an independent machine for distributing the type. In 1878 an arrangement was made with the Farnham Typesetting Company, of Hartford, Conn., for a distributing machine, and a combination was formed and a contract made looking to the introduction of machines using the Paige compositor and the Thompson distributor. About this time Mr. Paige invented his combined machine to contain the principal features of his compositor together with the leading features of the Thompson distributor, the type being taken from a galley and distributed into the bottom of the inclined channels, from which channels the type were delivered to an intermediate point in their length for purposes of composition. About 1881 a machine was completed for the double purpose of composition and distribution, but without provision for justification. A new machine was built by the Pratt & Whitney Company, and as early as July, 1887, type was automatically justified in the machine. The company passed through various vicissitudes, and the machine reached Chicago in 1892. Work was again started in February, 1894, and was pursued until August, 1894, when the first machine was completed and put in operation in the office of The Chicago Herald, and it is claimed that wonderful results were obtained, but the matter had been delayed so long, and the art had advanced so much in the meantime, that it was not considered practical to build the machine.

Having given the history and romance of this remarkable patent, on our editorial page, we are enabled, through the courtesy of Mr. Philip T. Dodge, the President of the Linotype Company, who presented one machine to Cornell and the other to Columbia, to give a short account of the actual operation of this wonderful machine.

We will now briefly describe the Paige machine. Of course, only the merest outline can be given of the wonderful mechanism of this remarkable creation of the inventor. The machine was designed to use one size of type. The model machines constructed were for nonpareil type. The machine was arranged to distribute dead matter into both type and space cases automatically, to set matter from the type case by means of a keyboard, to automatically justify lines of matter by inserting between the words a space of a thickness predetermined by a series of word measurements, and to finally place the matter in galleys, solid, single or double-leaded, as desired, all of these operations being performed at the same time and in perfect harmony with each other. The type is contained in the vertical channels of the type case, which is slightly inclined to prevent the long columns of type falling to the front.

The setting is performed by a horizontal row of setter plungers, each plunger being in register with its particular channel and character. These plungers in action pass through the type channels about two inches above the lower end of type column, pushing type out from the column, upon a raceway in front.

The setting action, after the key has been pressed by the operator, is purely mechanical, being controlled by a time lock device. Depressing a key operates through a horizontal wire to a vertical detented lever. This lever supports the rear end of an initial movement plunger, the front end of which engages with the setter plunger proper. The detented lever being pushed back by the key action, the initial plunger falls in front of it, and by the return of the detented lever is given a forward motion of one-quarter of an inch. This forwards the setter plunger in exact time to become engaged by a revolving wing shaft, which completes the plunger's movement and sets the type out upon the raceway. A second wing shaft, revolving in opposite direction to the first, returns both the setter and initial plungers to position, the initial plunger being lifted, so that its rear end rests again upon the detented lever. The key is returned by the action which gives the initial movement to the plunger. One key, or as many as can be used in spelling from left to right, may be pressed at one and the same time.

The type set out upon the raceway by the plungers are collected at the left-hand side of the case by the type driver, which sweeps the entire length of the setter raceway. Here the word is completed, and measured by a mechanical device. A touch of the word key, and the word is forwarded to the word raceway. Each word is measured, and kept separated from the other. An indicator on the keyboard shows when the line is full. The line key is then pressed, which transfers the aggregate word measurement to the space-selecting device, pushes a pin, one of a circle of pins contained in a revolving disk, and returns the measuring device to its zero position, in time for the succeeding word.

The space case is located at the left end of the machine, and arranged in the same general manner as the type case.

The line of separated words traverses the word raceway until the space case is reached. Each word is then carried across the front of this case by a long movement of the comb or conveyer. It is while the comb is returning for another word that the space is set out from the case; the next word forwarded, carries this space with it into the line. This continues until the line is formed, perfectly justified, upon a slide located over the setter galley. Concurrent with the assembling of the last word into the line, the pin, previously set by the line key action, engages to retract the slide under the line, and push the line down into the setter galley, single or double leads being inserted as desired. This continues until the galley is filled, indicated by an alarm, or until copy is exhausted.

The space case holds spaces of eleven different sizes. To determine the thickness of space necessary to justify a line, the measure of each word, as it is being set, is successively recorded upon a sliding bar. With the last word of the line measured, the bar has moved to the aggregate of the words contained in the line. Concurrent with each word set, pin blocks moving in an endless chain, and containing eleven sliding pins each, have been advanced step by step, so that when the line is finished a block for each word it contains has been moved into a position to engage with a plate, having raised blocks arranged in combination upon its surface. Twelve of these combination plates are contained in a horizontal grooved box. The plate to be advanced from this box to a position under the pin blocks is determined by the number of words contained in the line. The distance which it must be advanced that the proper combination of blocks may engage with, and set the pins in pin-blocks, is determined by the measure of the line recorded upon the sliding bar. The blocks and plate being in position, a slight vertical movement engages the two. Pins coming in contact with combination blocks are raised above the others. These blocks now move in unison with the line they represent, and reach the space case together, the words in front of the case, the pin-blocks at the rear. The space setter plungers are operated by a row of eleven vertical levers, engaging at the bottom with the plungers, and at the top in register with the pins in pin-blocks. The upper end of levers are made with a point projecting backward at right angle to the vertical, and raised slightly above the top of pins in normal position. As the first word of line is carried past the space case, the first block is moved in register with the vertical levers. A rocking motion carries the top of levers backward, engaging them with any pins previously raised by combination blocks. Any lever so arrested in its backward motion imparts an initial movement to its particular setter plunger, which sets the space out upon the raceway, to be carried along by the succeeding word into the line. Each block in turn is brought into register with the levers until the spaces are set and the line justified.

Dead matter, with leads and rules extracted, is placed in galley for distribution. A vertical movement registers the top line of type with a horizontal blade, which forwards it into a raceway. A longitudinal slide presses the end type into the cut-off, which separates it from the line, and raises it to the level of the distributor raceway, upon which it is pushed by a plunger, to be forwarded by a comb movement. The cut-off operates continuously, separating one type at a time from the line. All characters are forwarded to the right, to be distributed into the type case, while all spaces move to the left, to be distributed into the space case. A system of notches on edge of type, arranged in combination with a selecting device, enables the type to be distributed into their respective channels. The distribution is made into the bottom of the case, the column of type rising as each type is inserted. To prevent this interfering with the setting, which is performed at a point about two inches above, the distribution and setting are arranged to take place on different portions of the revolution of the machine.

Fishing With a Steam Pump.

Our French contemporary, Cosmos, describes a curious means of fishing which was discovered accidentally. It will not, of course, commend itself to sportsmen more than does the use of dynamite cartridges exploded in the water. A pond was being drained by a powerful steam-pump. Each stroke of the piston drew up about 25 gallons of water, and the pond was emptied in a few hours, and it was found that the fishes were also pumped with the water. A metal basket receives everything pumped. The water and slime escapes, and a boy collects the fish and assorts them according to species and weight.

Mr. Tesla's agent has left London for Lisbon to establish a receiving station on the Portuguese coast at the fortieth parallel of latitude, which will be in communication with a Tesla transmitter located on the New Jersey coast.

Automobile News.

Motor vehicles in Holland are coming into considerable use, and the prospects for American machines are good. The machines intended for Holland should be made narrower than those built for use in America, because the roads are too narrow to permit two machines of 4 feet 8 inches in width to pass each other. Carriages must not have more than 2,220 pounds weight on each wheel.

The French Postal Administration has been somewhat behind that of other countries in organizing an automobile postal service, but a system of specially constructed electric vehicles is to be shortly put into use. One of the first of these, constructed by the Vehicle and Automobile Company of Paris, was recently inspected by M. Mougeot, Postmaster General, and other officials who expressed themselves as greatly satisfied with this type of postal delivery wagon, and it is to be tested in actual service before long.

The date of the Gordon Bennett cup race has finally been agreed upon by the different clubs, and it is officially announced for the 29th of May. The Paris-Bordeaux race has been fixed for the same day, and will be run over the same route; there will be an hour's difference in the time of starting, the competitors for the cup starting first. Their record will class them at the same time in the cup race and the Paris-Bordeaux. The start will be made from Ville d'Avray about 3.30 A. M. There are nine competitors—three English, three French, and three German. Further information as to the route and the details of the race will be given later.

A race between an automobile and an express train was lately made at Rome, in which the automobile carried off the honors. It was the result of a discussion between M. Marino Torlonia, who affirmed that his machine would beat the express from Rome to Civita Vecchia (42 miles), and Commander A. Silvestrelli, who thought the contrary, and a wager was accordingly laid. M. Torlonia, although hindered along the route by the numerous vehicles, nevertheless won the bet by arriving at the station of Civita Vecchia just in time to see his opponent descend from his compartment, and was greeted with enthusiasm by the crowd of amateurs who had assembled to watch the result.

Some further particulars have been obtained as to the automobile system which is being organized for Madagascar. It is designed for freight and passenger transportation between the coast and Tananarive, a distance of 150 miles; it is expected to cover the route in 14 hours. The road, which has only recently been finished by the government corps, has many steep grades; the average grade is given as 6 per cent. The vehicles to be used in the system have gasoline motors of 8 horse power, and can transport, besides the conductor and a mechanic, 6 passengers and 700 pounds of baggage. The concession has been obtained by a French company, who have already commenced operations and expect to have the system in running order before long. A number of skilled mechanics, recruited from the automobile factories of Paris, have lately been sent to Madagascar, taking with them the tools and pieces necessary for repairing the machine. The repair shop which will be opened at first will no doubt develop later on into a factory for the construction of machines.

The Tour of Tunis will no doubt be one of the most interesting automobile excursions of the year, as will be seen by the following programme of the route and the different sites to be visited. It starts from Marseilles on the 22d of February. The packet boat of the Franco-Tunisian Company takes the excursionists from Marseilles to Tunis, and the visit to the city and environs, Carthage, etc., lasts till the 26th. On the following day an excursion of 30 miles is made to Zaghouan to visit the ruins of the aqueduct of Carthage. March 1st, Tunis-Sousse (85 miles) will be covered, and March 2d, Sousse-Kairouan (34 miles), with visit to the mosques; 3d, Kairouan-Sfax (102 miles), visiting the amphitheater of El-Djem; 4th, Sfax-Gabes (81 miles); 5th, Oasis of Gabes, thence returning to Tunis. On the 10th, an excursion will be made to Bizerte (34 miles), with a buffalo hunt at Djebel-Ackel and visit to the lake of Bizerte, the Arsenal, etc., returning to Tunis by the 12th. The members of the caravan will find along the route the different supplies necessary, such as gasoline, oils, pneumatics, etc., and besides they will be accompanied by an automobile wagon containing pneumatics, and another belonging to the Soudan Automobile Company with different pieces and tools, as well as a number of mechanics. Among the prominent sportsmen taking part in the excursion are the Count de Chasseloup-Laubat, with a 12 horse power Panhard & Levassor machine; Etienne Giraud, with the 24 horse power prominent in the Paris-Toulouse race; Count de Chabannes, with a Serpollet steam automobile; the Commandant Cagniaut, M. Jannin, Director of Public Works, and many others.

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Science Notes.

Canada still has a wild herd of buffalo. Traces of the existence of the animals were found in the woods at the west of Slave River. It was ascertained that the buffalo was being mercilessly hunted and destroyed by the Indians.

Mr. D. O. Mills has given $24,000 to pay for a two years' astronomical expedition from the Lick Observatory to South Africa or Australia with the object of studying, under good conditions, the movement of the stars in the line of sight.

A highly reflecting metal unaffected by air or water is, of course, very suitable for specula. Such material is magnalium, or an alloy of aluminium and magnesium. It is attacked by alkalies, and therefore should not be brought into contact with them or with soap.

The Ontario government has reserved 1,400,000 acres of wild land near Lake Temagami, a great lake lying west of Lake Temiscaming, on the Upper Ottawa. This will be used as a national park where the timber will be preserved and the game will be allowed to increase. The number of beavers and deer is increasing.

An attempt is being made to free the streams of Louisiana and Florida from the water hyacinth. Hundreds of skiffs and small vessels have been caught by the water hyacinths, and are unable to get out of the streams in which they were used. The drainage canals in New Orleans are in peril, and the logging industry of Southern Louisiana is in danger of destruction. There is room for a new and successful process.

There has been an increase of nearly $30,000 in the value of monkey skins exported from the Gold Coast, and the warnings issued by past colonial governments have been unheeded. In 1896 it was reported that during the six previous years no fewer than 884,768 skins had been exported. It is only skins that are in good condition, with few shot-holes, that are capable of being disposed of. It is estimated that during this period as many as a million of monkeys have been massacred in the Gold Coast district alone.

We have already noted the penny-in-the-slot directory. A new modification of the scheme is now on the market, in which the book, instead of being placed in a box whose cover lifts up, the covers of the book are held in rigid supports which are hinged to the top of the stand. A penny is dropped in the slot, the knob is pushed, and the directory can then be consulted. After the desired address has been obtained, the book closes and locks automatically. Each druggist is furnished with thirty slugs for opening the book for his own use, and is also given a percentage on the receipts, and a new directory every year.

A recent find of neolithic flint implements near Ratisbon is of considerable importance as tending to upset existing theories. An immense ax-head, more than a foot long and three inches broad, was found in Alsace. In the middle of one of the broad sides of the ax-head is a representation of the human form, skillfully chased and still clearly visible. The face is large and long, with clearly perceptible eyes, nose, mouth and chin, but without ears or hair; the arms and hands are extended as if in prayer. There are parallel lines crossed by others, similar to those on the neolithic burial urns found near the left bank of the Rhone, and now preserved at Worms. The figure now discovered is supposed to represent some Phallic deity of Rome or Phœnicia.

The Wholesale Seedsmen's League has issued a protest against the free distribution by the government of seeds obtainable at every seed store. It states that this is a serious perversion of an admirable scheme for the improvement of agriculture and horticulture. The government possesses vast opportunities for the collection of new fibers and grains and plants of unintroduced and promising qualities through the agencies of its consuls in foreign countries. The seed trade would welcome such activity on the part of the government, but it does but little of such work, while depressing the regular trade by distributing the same sort of seeds merchants expect to sell. In 1896, the free distribution of seeds amounted to 10,000,000 packets, and now it has reached 24,000,000 packets.

The excavation of the site of the church of Santa Maria Liberatrice in Rome has brought to light one of the most interesting ecclesiastical relics in the world. This is the Basilica of the Virgin, probably the oldest church dedicated to the Virgin in Rome. It has a total width of 55 feet, with a narthex and atrium occupying the inner easternmost hall of the Augusteum. It is rich in the remains of damaged and fragmentary frescoes of the eighth century, executed when the church was extensively restored by Paul I. Prof. Boni discovered on Christmas eve the mutilated fragments of an inscription of the eighth century, of which the concluding portion is still legible. It confirms the great antiquity of the building, as it states it was "old" at that time. To have been known as old in the eighth century is certainly proof of a very venerable age.

Engineering Notes.

The official returns of the commerce of France for the year 1900 show a decrease. They amount to 4,408,530,000 francs, as compared with 4,518,308,000 francs for 1899. The exports for 1900 also decrease, being only 4,078,032,000 francs, as against 4,152,635,000 francs in 1899.

Hereafter the Baltimore & Ohio Railroad will not engage engineers weighing 200 pounds or over, although those now in the employ of the company will not be dismissed for this cause. The reason for the rule is said to be the narrowing of the space for the engineer caused by the extension of the boiler through the cab of the newer types of engine, and large engineers might not be able to move rapidly enough in emergencies.

Out-of-date Parrott and other old-style army and navy guns are destroyed daily near Reading, Pa. The guns weigh from thirteen to twenty-five tons. The work is accomplished at Fox Hill, in Warwick Township, Chester County. Six men are employed in the log forts in the ravine. They make about 350 blasts a day, and tons of dynamite are used each month. The heavy timber forts are 24 feet square, and the sides are heaped high with earth. The guns are rolled into the forts from the flat cars and are drilled by steam power. The dynamite cartridges in the guns are discharged by electricity. The forts prevent the pieces from being hurled into the air.

A new firearm is being introduced into the German army. It is of rather a complicated design, but it is claimed to be a perfect weapon regarding its firing capabilities. The barrel has been made more substantial than that of the Mauser, while the soldier's hand is protected from the heat of rapid firing. The magazine is loaded from a charger, instead of the clip, the advantage of which innovation is that it can be loaded with great rapidity either from the right or left. Automatic elevating in connection with the sighting is also provided. The only drawback to the weapon is the delicacy of its construction, which will render the arm liable to derangement with rough usage.

Prof. Gustave Bischof, of the Glasgow University, has invented a new process for the manufacture of white lead. His plan is the conversion of metallic lead into litharge, by means of water gas at a temperature of 300 deg. C., to suboxide. Sufficient water is then added to moisten this suboxide, which is converted into hydrate. This substance is then inserted into a gas-tight apparatus, and by means of carbonic and diluted acetic acid manufactured into white lead. Under the old process white lead occupied from two to three months in its manufacture, but Prof. Bischof is enabled to make a purer article within less than forty-eight hours at a much cheaper price and with perfect safety to the employes. The naval and military departments have tested the product and have found it perfectly satisfactory.

The United Kingdom continues to be the chief of the foreign patrons of the Carrara quarries. According to the latest official returns, out of 161,259 tons exported 40,089 tons, or one-fourth the entire quantity, came to England. The United States may soon take the lead, for the quantity credited to them was 39,857 tons. Italy required 43,909 tons. The quarries extend from Carrara to Massa and Versilia. Altogether there are 1,264, but 793 of them are not worked. The men employed number 6,522 at Carrara, 1,100 at Massa, and 2,533 at Versilia. The last year's products are returned as having the value of 9,808,520 Italian lire. It is often supposed there is great loss of life at the quarries, but during 1898 there were only 40 serious casualties among the workers, by which 7 quarrymen were killed and 33 were injured, of whom 3 were permanently deformed and the remainder recovered. Slight casualties numbered 729.

The efficacy of the Lee-Enfield rifle, the small arm used in the British army, has been exemplified upon several occasions, while repeated experiments have been made to compare its characteristics with the Mauser arm. The latter rifle has generally been considered to be the better firearm, both in carrying and quick firing capacity. Recent experiments conducted in India, however, disprove the latter statement. The Lee-Enfield rifle carries ten cartridges in its magazine, while the Mauser carries five. The former arm, however, is generally employed as a single loader. The objects of these experiments were to determine respectively the time occupied in firing 20 rounds when used as a single loader, and when utilized with the magazine. In the first test the 20 rounds were discharged in 2 minutes 2¼ seconds. When the magazine was brought into use the same number of rounds were discharged in 1 minute 26 seconds. With the Mauser rifle, however, 1 minute 53 seconds were occupied in discharging the same number of rounds, thus showing that a more rapid fire can be maintained by the Lee-Enfield arm.

Electrical Notes.

Dr. Mayo G. Smith, who was associated with Morse in constructing the first telegraph line between Washington and Baltimore, died on February 20.

The steady growth in the number of direct-coupled generating sets has interfered seriously with manufacturers of belting.

No new single-wire telephone circuits will be allowed in Switzerland, and the companies must also convert their lines to metallic circuits and contribute toward the cost of moving the wires crossed by electric-power circuits.

At the close of the year 1899 there were in Germany 12,710 telephone offices, an increase of 1,214 during the year. The number of subscribers was 159,561, and 574,000,000 conversations took place. The service employs 6,724 persons.

Special cars are provided for visitors in Washington, by which they can obtain a general view of the many interesting things for which Washington is noted. Special cars run over the lines of the Washington Traction and Electric Company's system.

A large turbine installation is now being constructed on the Glommen River, in Norway. The falls are estimated to be of 16,000 and 10,000 effective horse power respectively. They are located about 25 miles from the capital, and the object of the undertaking is to supply Christiania and adjacent parts with electricity for lighting and power.

Rome will soon be connected with Paris by a telephone line. The work has been in progress for many months, and the Italian government has completed the installation of the wires on the Italian slope of the Alps. The French government is at work on the line on its side, and it is thought that communication between the two cities will be accomplished during the summer.

The proprietors of the sole aluminium works in Great Britain propose to appeal for an extension of their Héroult patent. The reason for this decision is not quite apparent. The company enjoys a powerful monopoly, so far as Great Britain is concerned, and it is highly improbable that they will encounter any competition in the market, owing to their being firmly established. Such an appeal is a very costly process, and the only other motive for incurring such heavy expense is the fear of acute competition from America. During recent months large shipments of the American product have been dispatched to Great Britain by arrangement with the British Aluminium Company. When the patent has expired, the American firms will not be under any restrictions, and will therefore be able to enter the open market to the detriment of the English company.

A photograph, which is said to be the largest in the world, was recently taken of the general office of Swift & Co., at the Union Stockyards, Chicago. This room has a floor area of 46,918 square feet, and here 700 clerks are employed. A large number of flashlights had to be lighted simultaneously, so that electricity was used, says The Western Electrician. A storage battery with twenty cells was installed temporarily and connected to the temporary circuit in pairs, giving a pressure of four volts and a large current capacity. Three hundred charges of flashlight powder were arranged around the room, and the fuses to ignite them were all connected in multiple to insure simultaneous ignition. A stage was built in one corner of the room for the large camera. The plate used was 4½ by 8 feet in size. A heavy plate-glass plate was coated with emulsion for the purpose. In developing it, four men were required for its handling.

Mr. W. Langdon, the superintendent of the electrical department of the Midland Railroad, of Great Britain, recently read a paper before the Institute of Electrical Engineers, upon the practicability of converting the trunk railroads from steam to electric traction, and the numerous benefits that would accrue from such a change. He contended that the utilization of electric traction for this purpose was perfectly feasible, and he was of opinion that the railroads could be worked much more economically by this means. He had obtained returns of the trains running over the main road of the Midland Railroad between London and Bedford, a distance of 50 miles, in order to ascertain the amount of current required to deal with it, and the cost of installing and maintaining the necessary generating plant. From his deductions, he discovered that the capital outlay for the installation of the plant would amount to $2,350,000, and the annual expenditure would aggregate about $194,800. In comparison with the cost of working the same distance by steam traction, an economy of nearly two cents per train mile would be effected by the employment of electricity. At the present time, owing to the high price of coal, the saving would be much greater. If all the railroads of the United Kingdom were to adopt electricity for the propulsion of their trains in place of steam, no less than 3,000,000 tons would be saved per annum.

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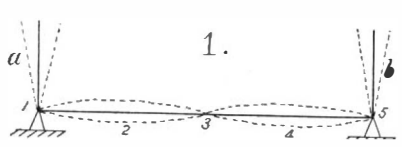
THE SLABY SYSTEM OF WAVE-SELECTIVE WIRELESS DUPLEX TELEGRAPHY.

Hertz found that a spark is capable of exciting an electrical disturbance in a straight wire, which disturbance is propagated in waves through space with the velocity of light, and that these electrical waves were capable of exciting electrical disturbances in other electrical conductors which they encounter. Since the brilliant discovery of Hertz, physicists have succeeded in augmenting these effects. The electrical disturbances set up in a wire by a spark from an induction coil and transmitted ethereally to a second parallel wire through a distance of one meter are such that a spark 5 centimeters in length can be obtained from the second wire. In the dark both wires would glow with equal intensity. Hertz discovered that these phenomena could be explained by physical laws. To the electrician was assigned merely the task of intensifying the phenomena.

The electrical phenomenon exhibited by the two parallel wires is oscillatory in character and is produced by an electrical tension alternating between its positive and negative maximum value some five million times in a single second. These alternations are not equally distributed along the length of the wire. The electrical effect increases toward the free end of the wire.

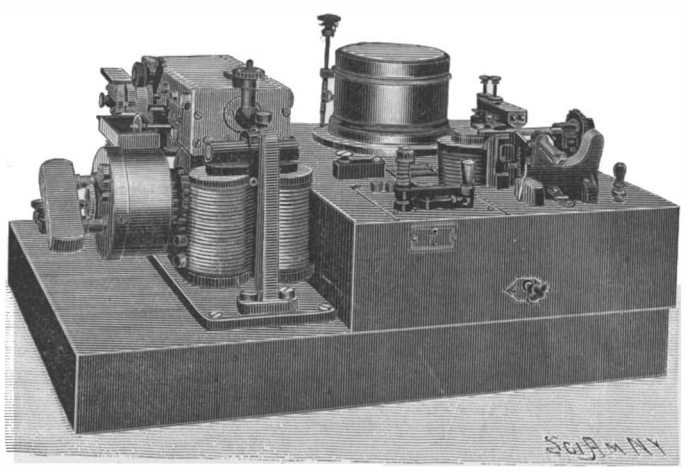
If a straight steel wire be screwed at one end in a threaded socket, and the free end vibrated, oscillations of a similar character will be produced. The amplitude of the waves is greatest at the free end. Exactly the same increase of amplitude occurs in the electrically excited wire. The transmission of the electrical disturbance by wave propagation can also be clearly explained by a mechanical analogue. If the steel wire be bent to form a right angle having equal legs, and if the angle be firmly clamped to a fixed object, the disturbances excited in one end of the wire will be transmitted to the other end. The fixed point is the node, and the more strongly excited portions of the wire are the crest of the wave. The motion set up in the second leg can be further transmitted. If a steel wire of six times the length of the free leg be twice bent so as to form two right angles, then at 2 and at 4 a loop will be formed, and at 3 a node. Through the fixed node, 5, the motion is transmitted to the vertical wire, *b*. Within a short time after *a* has been set in vibration *b* will begin to vibrate in unison. The transmission is effected by so-called stationary waves in the connecting steel wire. The entire length, including a wave-crest and a wave-valley, comprises a wave-length. The length of the freely-vibrating wire must be one-quarter of a wave-length—that is the underlying law of transmission. Similar conditions prevail in the electric wire. The electrical vibrations set up in the vertical wire, *a*, by means of a spark at its lower end, form a vibratory crest at the upper end of the wire, the frequency of which depends upon the length of the wire. These vibrations are propagated in the ether with the velocity of light in the form of waves, the lengths of which are exactly four times those of the electrically vibrating wire.



Vibration of a Steel Wire.

The second wire, *b*, placed at any distance from the first will be electrically oscillated by these waves, the oscillations being strongest if they correspond with the wave-frequency; that is, if the length of the wire be exactly one-quarter of the wave-length, and if the lower end be a node. Both conditions can always be attained; for the length can be varied at will, and the lower point can be made a node by connecting it with the earth.

A spark could hardly be obtained by contact with a metallic object, as in the previous example; for the electrical effect diminishes with the distance traversed. In order to detect this small electrical impulse, a coherer is employed, of the type used in most systems of wireless telegraphy. Evidently the coherer should be connected with that portion of the wire at which the alternations are greatest. It has hitherto been the custom to suspend the wire and to secure the coherer to its lower end, the other pole of the coherer being connected with the earth. It has been proven experimentally that the capacity of the coherer is so great that the lower end of the receiving-wire may be regarded as a node for the electrical oscillations of the wire. But since the effect is dependent upon the tension to which the coherer is subjected this arrangement, according to Prof. Slaby, is radically wrong. No means are provided for the utilization of the maximum tension to which the receiving wire is also subjected. The fairly good results which have been obtained with this arrangement are due only to the fact that the length of the receiving wire is not exactly equal to one-quarter the wave-length and that the transmitter sends forth incidental waves besides the main waves, so that the lower end of the receiving-wire may permit the formation of minor tensions.


A DETAIL OF THE APPARATUS.

Slaby has found that the receiving-wire must be grounded in order to form a node for the waves. At the free end of another wire of equal length connected at the node with the receiving-wire, a wave-crest will be formed of the same amplitude as that produced at the free point of the receiving-wire. The auxiliary wire can be wound on a bobbin, if it be so desired. By these means a degree of precision has been obtained which is remarkable. The new arrangement enables one to utilize as receiving-wires lightning-rods, flagpoles, and other iron uprights which are already grounded.

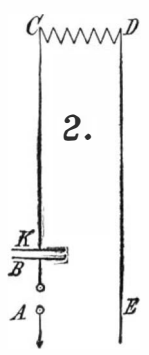
It has hitherto not been possible so to synchronize two stations that they would transmit and receive messages without interference from the electrical waves sent forth by other stations. Marconi is said to have solved the problem; but the means which he employs have not as yet been published.

If the length of the receiving-wire be exactly equal to one-fourth of the wave-length or to an uneven multiple of the wave-length, those waves for which the grounded point is not a node will not be received, but will be conducted into the earth. In other words, the electrical waves are sifted, and only those are received which are of the proper length. In this manner Slaby transmits and receives messages in secret.

For those waves which are exactly four times as long as the receiving-wire, the ground-point is a node, even though minimum tensions may occur here. If the auxiliary wire be exactly as long as the receiving-wire, then all waves which have not the requisite length will pass through the node into the earth. But these waves can also be received and conducted to an auxiliary wire if the entire length of the receiving-wire (that is, the receiving-wire plus the auxiliary-wire) be made equal to one-half the wave-length. The earth-point is then no longer a true node for these waves, but permits their passage without much diminishing their effect. All other waves, however, are rejected as it were. If, for example, it be desired to receive at a lightning-rod 40 meters in height waves which are not $4 \times 40 = 160$ meters in length, but rather 200 meters in length, then the entire length of the receiving-wire must be 100 meters. In other words, we must add an auxiliary wire 40 meters in length to the lightning-rod. By this simple means it is possible to enable a station to receive waves of various lengths. It is necessary merely to provide a sufficient number of coils or bobbins of auxiliary wire and to set up receivers equal in number to those of the stations with which it is desired to communicate. For the filtering of the waves is so accurate that it is possible to receive several messages from different directions and distances with a single receiving apparatus.

In order to obtain greater accuracy and to increase the effect of the electrical waves, Slaby employs a simple apparatus consisting of a coil of wire of a size and winding dependent upon the wave-length. The coil has the property of reducing the velocity of an electrical impulse. But such a reduction of velocity results in considerably increasing the tension, for which reason Slaby calls this apparatus, for lack of a better name, a "multiplier." This apparatus is not to be mistaken for a transformer; for it has no secondary winding.

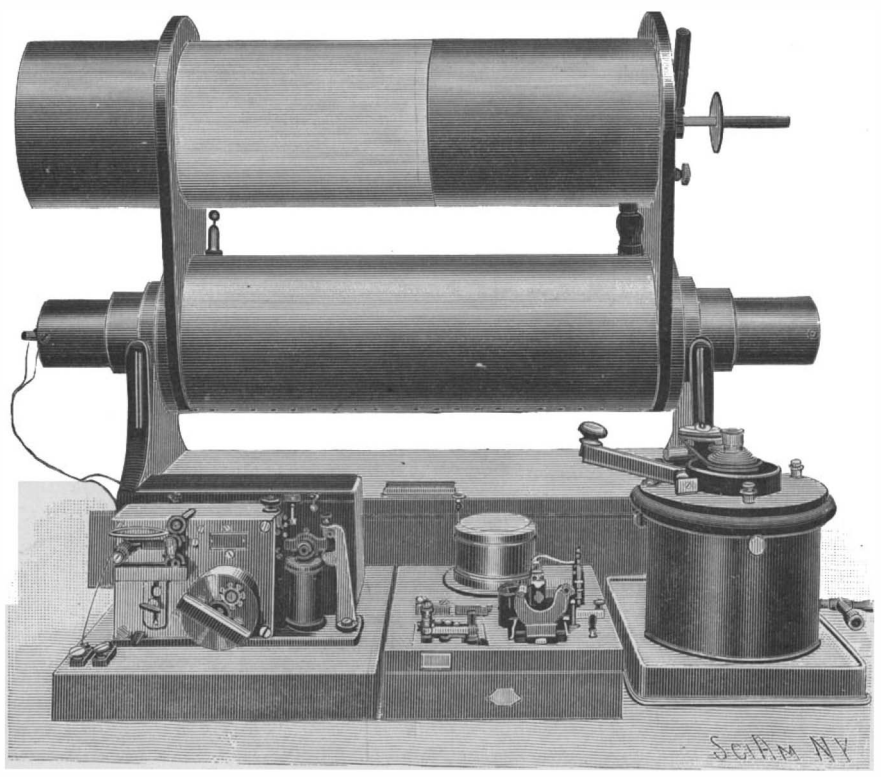
By an acoustic analogue the operation of this multiplier can be explained. A tuning-fork set in vibration by a blow is acoustically oscillated exactly as the receiving-wire is electrically oscillated when subjected to the influence of ethereal waves. But the tone produced by the fork soon fades. This diminution of sound is due to the resistance which the fork must overcome. But if the vibrating tuning-fork be placed upon a resonator, the tone becomes louder and lasts for a longer time. The property possessed by a resonator of sustaining acoustic vibrations and increasing their amplitude finds its counterpart in the power possessed by the multiplier of intensifying and refining electrical oscillations.



The Slaby Receiver.

If a multiplier-coil be placed between the auxiliary wire of the receiving-wire and the coherer, great tensions will be obtained at the coherer; for which reason the certainty of transmission is increased. The multiplier permits the passage only of those waves to which it is attuned, as it were; all other waves, if they should by any possibility pass the node, will be reflected by the coil.

It now remains to be shown exactly how electric waves of definite length are produced at the transmitting station. Wireless telegraphy is essentially the electrical transmission of power. The transmitting apparatus which is capable of translating the largest possible amount of electrical energy into an oscillating form will evidently be the most suitable for the purpose. But to effect such a translation, not only a high tension, but also a large quantity of electricity is necessary. For this purpose a grounded transmitting loop (Fig. 2) instead of an insulated wire is used, which loop is provided with a condenser, *K*, to increase the quantity of electricity. The condenser used consists of Leyden jars. To charge these jars the entire circuit of the ribbon, including the earth, is employed; to discharge the jars only the vertical conductor, *K C*, is utilized. To prevent the passage into the earth of electrical oscillations produced at the discharge, a coil, *CD*, is fitted to the conductor, which coil not being in unison with these electrical vibrations, prevents their escape. We have seen how such a coil can act as a barrier. Electrical waves are then sent forth by the first vertical wire and are not disturbed by any counter influence exerted by the second vertical conductor, *D E*. Electrical waves thus transmitted are proportionate in length to the length of the wire employed and to the size of the condenser. By employing coils, *C D*, of various forms the length of the waves can be changed, such coils serving to vary the frequency of the oscillations. Each frequency corresponds with a certain wave-length.


A COMPLETE APPARATUS SHOWING THE MULTIPLIER, INTERRUPTER, RECEIVER, AND MORSE TRANSMITTER.

In a lecture Slaby succeeded in receiving messages from stations of 4 and 14 kilometers distance with a speed of 72 letters per minute. He likewise received messages simultaneously from the two stations. His system has proven so successful that it will be developed by the Allgemeine Elektricitäts-Gesellschaft, of Berlin.

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Germany's Two Great Coal Regions.

BY H. L GEISSEL.

Prof. Schulz, German Privy Councilor of Mines, and a recognized authority on European mining matters, has just given out some interesting figures on the coal deposits of the two great German mining districts. Prof. Schulz says that the Rhenish Westphalian mining region extends over an area of 60 square miles. To a depth of 700 meters there are yet available and exploitable 11,000,000,000 tons of bituminous coal; from that depth to 1,000 meters there remain 18,300,000,000 tons; and in the depth between 1,000 and 1,500 meters, well accessible under present mining conditions, there are another 25,000,000,000 tons, or, altogether to the last-named depth of 1,500 meters, 54,300,000,000 tons. Prof. Schulz expresses the opinion that science will improve our present means to such a degree that in time it will be possible to safely carry on operations at a greater depth than 1,500 meters, whereby another 75,000,000,000 tons of coal would be obtainable. Thus, the total quantity of coal still buried in the Rhenish Westphalian district amounts to 129,300,000,000 tons. Supposing the future annual output of the district should average 100,000,000 tons—that is to say, about twice the present output—the coal deposits available down to a depth of 1,000 meters would still last for 293 years, and to 1,500 meters for 543 years.

The second coal region, the Upper Silesian, is even larger. Here the carboniferous mountains reach a depth of 7,000 meters, on an area of 2,162 square miles, and the 114 workable layers have an average thickness of 170 meters. When calculating the quantity of coal workable to a depth of 1,000 meters, it must be taken into account that the carboniferous mountains generally are covered by younger layers about 200 meters in thickness, and that, when carrying on operations to a depth of 1,000 meters, about 33 1-3 per cent has to be deducted for safety constructions, loss, etc. There would thus remain, according to Prof. Schulz's estimates, a quantity of 62,800,000,000 tons of workable coal down to 1,000 meters. During the period from 1748 to 1900 there have been extracted 500,000,000 tons, thus leaving 62,300,000,000 tons to be mined. According to the Upper Silesian mining returns, the increase in the output from decade to decade has been 43.5 per cent. In 1899, when the deepest shaft was but 594 meters, the output amounted to 23,500,000 tons. Supposing that it reaches within 50 years three times the present output, the deposits down to 1,000 meters would last for 890 years, and would probably not be exhausted until the year 2790. At a depth of 1,000 to 1,500 meters there are further available 101,550,000,000 tons, and from 1,500 to 2,000 meters another 140,800,000,000 tons, the mining of which would require 1,450 and 2,000 years respectively. But, even at that time, there would yet be immense quantities of coal available, as huge deposits extend over the mountains deeper than 2,000 meters.

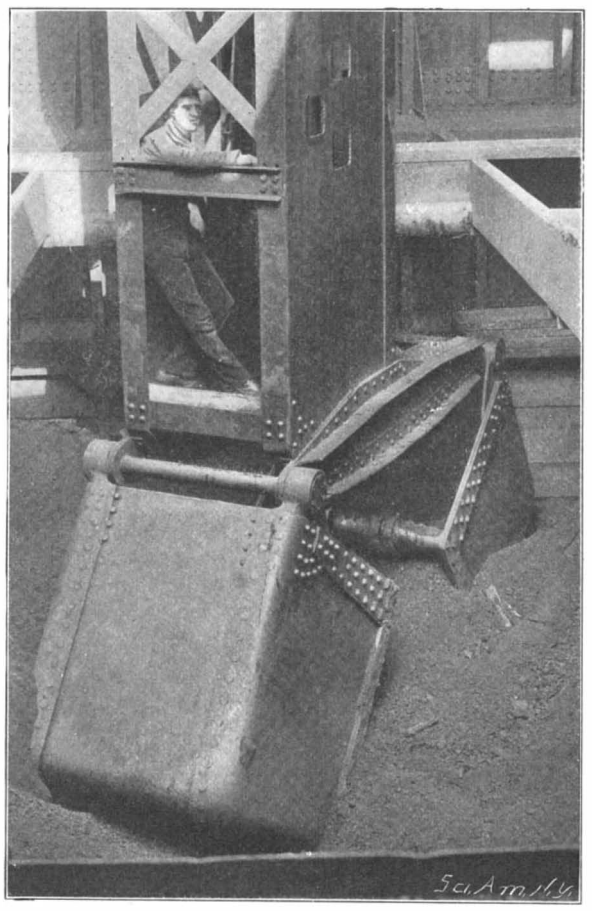
How the Welsbach Mantle is Made.

The "mantle" of the Welsbach light is an ash consisting mainly of the oxides of certain rare metals—lanthanum, yttrium, zirconium, etc., which are rendered incandescent by heating to a high temperature. A six-cord cotton thread is woven on a knitting machine into a tube of knitted fabric of a rather open mesh. This web has the grease and dirt thoroughly washed out of it, is dried and is cut into lengths double that required for a single mantle. It is then saturated in a solution containing the requisite oxides, wrung out, stretched over spools and dried. Next, the double-length pieces are cut into two, the top of each piece is doubled back and sewed with a platinum wire, which draws the top in and provides a means of supporting the mantle, when finished, from the wire holder. After stretching the mantle over a form, smoothing it down and fastening the platinum wire to the wire mantle holder, the mantle is burned out by touching a Bunsen burner to the top. The cotton burns off slowly, leaving a skeleton mantle of metallic oxides, which preserves the exact shape and detail of every cotton fiber. The soft oxides are then hardened in a Bunsen flame. A stronger mantle is made upon lace-making machinery.—The Keystone.

AUTOMATIC ORE UNLOADER.

BY W. FRANK M'CLURE.

Three great automatic iron ore unloaders, the first of their kind in the world, will be in operation upon the docks of the Carnegie Company at Conneaut, Ohio,



THE SCOOP GATHERING UP ITS LOAD.

Harbor the coming season. The complete success of these machines will mean their general adoption along the Great Lakes, and, incidentally, the realization of the fondest hopes of many of the big dock companies. Their use at all the ports will revolutionize the ore-handling industry.

For years pessimists have prophesied that a successful automatic iron ore unloader was an impossibility. Futile attempts to build such a machine have been made from time to time in the past decade. The announcement, therefore, that Andrew Carnegie was to build an automatic ore unloader at a cost of $100,000 occasioned no little interest.

On completing the first machine some time ago it was found necessary to rebuild it. Additional bearings in particular were found to be needed. Each test of the machine has been more satisfactory than the former one, and when last year the Carnegie Company ordered two more machines of the same pattern completed for this season's business, at a cost of $100,000 each, it was apparent that the steel king felt sure of their success. The three machines have now been completed. The accompanying photograph shows them, side by side, each in operation but in different positions.

The total weight of the first machine was found to be 400 tons and its height 55 feet. The all-important part of the machine is the bucket, which grasps ten tons at a single lift, or ten times that lifted by the largest ore bucket previously used. This great bucket is attached to a revolving pending leg, which in turn swings from a long and gigantic arm. This arm is carried forward and back upon a track, to a point above the vessel when the bucket is to be filled and to a point above the car when the bucket is to be dumped.

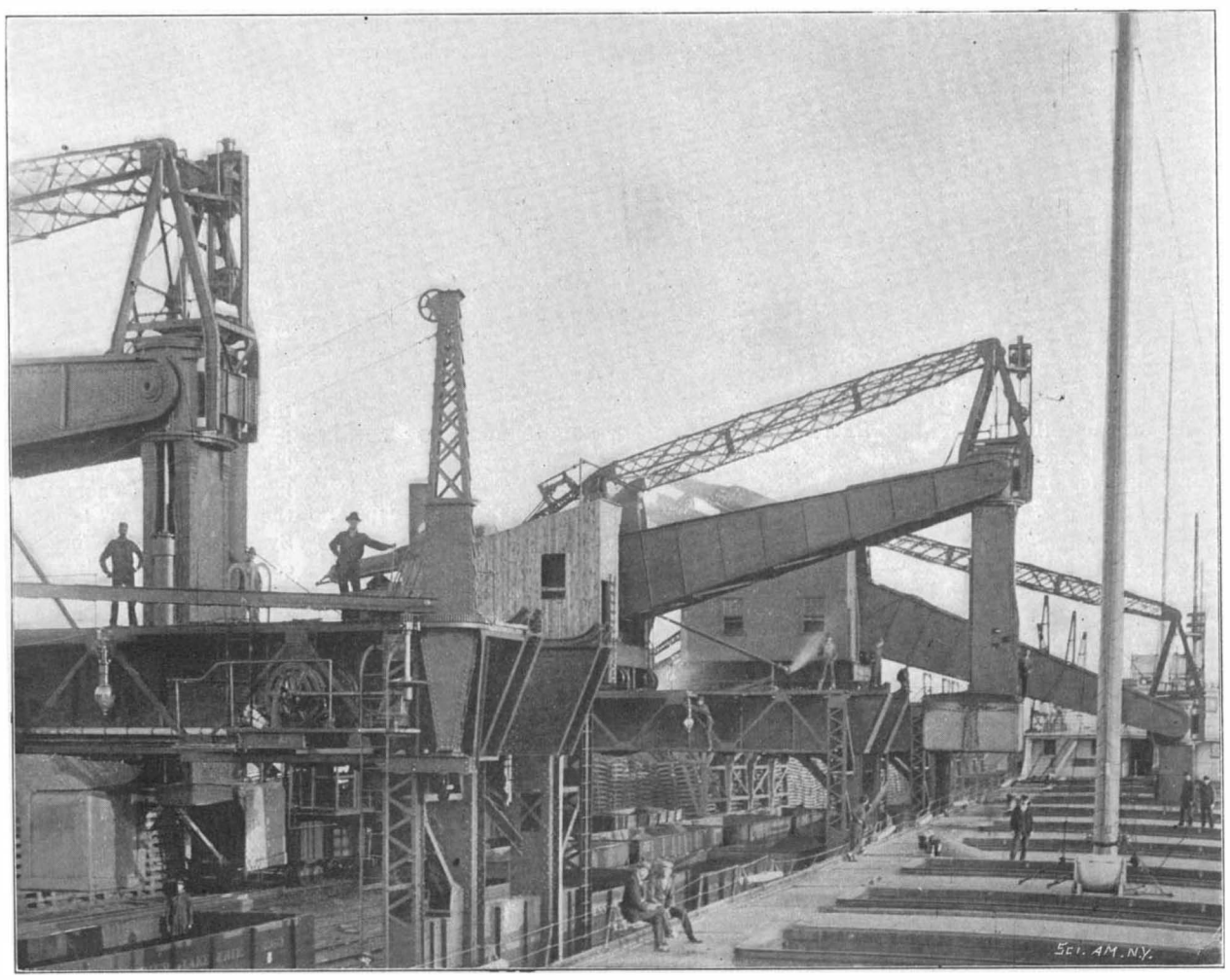
The bucket is first lowered part way into the vessel's hold. Next the scoop is opened and then lowered until it strikes the ore cargo and sinks deep into it. When open, the bucket has a spread of nineteen feet. The scoop is closed upon the ore by hydraulic power. It is then ready to be raised and conveyed to a point over the car into which the ore is to be dropped. Where the ore is to be placed on the stock piles, it is dropped into a trolley car which will convey it.

The automatic ore unloader is expected to take out from 90 to 95 per cent of the ore in a vessel. The bucket when below the hatch of a vessel can be swung around lengthwise, in which case it reaches about nine feet from the edge of the hatch in either direction. The small amount of ore which cannot be reached by the scoop is shoveled by hand to a point within its grasp.

In the accompanying photograph showing three machines, the big scoop or bucket of the machine in the distance is below the hatch of the vessel, reaching into the ore. The scoop of the next machine is raised to a point above the vessel, and the view nearest the reader shows the scoop after it has been conveyed and the contents dumped into a railroad car.

Four machines, side by side, can be used in the average vessel at one time. Each machine is expected to remove 300 tons of ore per hour when fully perfected. Four machines, thus unloading 1,200 tons per hour, would empty the largest vessel on the lakes in a comparatively short time. The largest cargo of ore hauled last year on the Great Lakes aggregated 7,446 gross tons. If such rapid handling of iron ore can be secured, the work of many men will be saved. One of the ore unloaders can be operated by six men. Three of this number remain in the vessel to shovel ore within the reach of the scoop. Three operate the machine. With four machines working in a vessel twenty-four men would thus do the work which usually requires 100 men.

As yet no attempts have been made to establish speed records. Otherwise the tests are reported to be very encouraging. George H. Hulett, a mechanical engineer of Akron, Ohio, is the inventor.



POWERFUL AUTOMATIC ORE UNLOADER IN USE, SHOWING DIFFERENT POSITIONS OF THE MAIN ARM AND BUCKET.

The Sunflower.

Dr. Harvey W. Wiley, Chief of the Division of Chemistry, United States Department of Agriculture, in a special report shows that the sunflower can be grown successfully over large areas in the United States; that it is a crop which makes a considerable drain on the elements of soil fertilizers; that one of the most valuable constituents of the plant is the oil, which exists in large quantities in the seeds; that the economic production of the sunflowers is now confined almost exclusively to Russia, where it is an agricultural industry of considerable importance; that in the United States it is grown as an ornament and for the production of seeds, which are used chiefly for poultry and bird feeding and for condimental and medic-

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inal properties with farm animals; that the oil of the sunflower seed is not produced commercially in the United States; and that in the cultivation of the sunflower the methods pursued for growing Indian corn are to be followed, and the plant is capable of cultivation over almost as wide an area as Indian corn.

A PAIL FOR LIVE BAIT.

Every fisherman knows how difficult it is to keep minnows alive. If the fish are kept in a pail, the water must be constantly changed to furnish a new supply of oxygen. The difficulty thus presented of

A NOVEL LIVE-BAIT PAIL.

feeding sufficient oxygen to enable the fish to live not only for hours, but for days, has been very ingeniously overcome in an invention for which Mr. Cassius M. Fisk, of Napoleon, Ohio, has taken out a patent.

Mr. Fisk's invention is a pail which is provided with an air-chamber in its bottom and with a hand-pump secured to the side. The lower end of the pump-cylinder communicates with the air-chamber by means of a pipe; and the air-chamber communicates with the body of the pail by means of a flexible pipe. The pail having been filled with water and the minnows placed therein, the hand-pump is operated to fill the air-chamber with compressed air. Such is the pressure that the air is spontaneously supplied to the fish in the water through the flexible pipe. It is necessary to pump fresh air into the chamber only at very long intervals; for the construction of the flexible pipe is such that the air is very gradually discharged.

The inventor assures us that he has subjected his device to most severe tests. Forty fish, among them minnows so delicate that they cannot ordinarily be kept alive for more than ten hours, were placed in the pail and supplied with air in the manner described. So efficient was the apparatus that after twelve days the fish were all alive, although the water had not been changed during the interval and had become very foul. When the supply of air was at that time cut off, the fish came gasping for oxygen to the surface. The same minnows could not be kept alive in the same amount of fresh water for more than fourteen or fifteen hours.

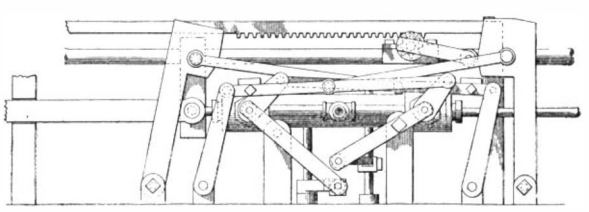
New Compounds of Cobalt.

M. Ducru has recently presented to the Académie des Sciences the results of a series of experiments in which he has formed several new compounds of cobalt. If to a solution of cobalt containing ammoniacal salts and a sufficient proportion of free ammonia is added arsenic acid or a soluble arseniate, a gelatinous precipitate, very voluminous, is seen to form, its color being more or less violet. At the ordinary temperature these precipitates are not modified, but if the flask containing the liquid and precipitate is kept near the boiling point in a water bath, the precipitate is slowly modified; it contracts and is transformed into another of a rather dark red which microscopic examination shows to be entirely crystallized. The duration of the experiment is variable; with concentrated solutions in the proper proportion it may take but a few minutes, but with weak solutions as long as 100 to 150 hours are required. The crystalline compounds thus obtained are cobaltous salts; under the microscope they are seen as needles grouped in clusters, and sometimes in rhomboidal plates. They have a marked action upon polarized light, and belong to the clinorhombic system. They are insoluble in water and weak ammoniacal solutions, but easily soluble in the mineral acids. At the ordinary temperature they lose ammonia, but very slowly. These compounds, which M. Ducru has thus obtained for the first time, are ammoniacal arseniates of cobalt, but their composition varies. While the proportion of cobalt and arsenic is practically the same for all these products, that of the ammonium may vary from zero to 8.6 per cent. It is not the proportion of ammoniacal salts in the solution, but the amount of free ammonia which determines the proportion. The superior limit is reached when the liquor contains 350 per 1,000 of ammonia (20 per cent strength) or 69 parts by which of NH_3. The salt obtained under these conditions is a tri-ammoniac arseniate of cobalt, having the formula $(As\ O_4)_2\ Co_3 + 3\ NH_3 + 5\ H_2\ O$, which approaches the zinc salts obtained by M. Bette. On the other hand, the action of this salt upon the salts of cobalt in presence of ammonium salts (without free ammonia) gives a pale rose salt, crystallized in fine needles, in cotton-like clusters. This salt contains no ammonium, and its composition $(As\ O_4)_2\ Co_3 + 8H_2\ O$, is that of natural erythrine; the crystalline form and grouping are the same. M. Ducru has isolated two of these salts which lie between erythrine and the first mentioned compound; the mono-ammoniac salt $(As\ O_4)_2\ Co_3 + NH_3 + 7H_2O$ is formed when the solution contains 15 per 1,000 of free ammonia, while the di-ammoniac salt $(As\ O_4)_2\ Co_3 + 2NH_3 + 6H_2O$ is obtained at a concentration of 60 per 1,000. The four salts thus obtained appear to be distinct compounds and not mixtures. The experimenter intends to describe a similar series of nickel salts and also a new method of analysis for arsenic which is based upon these experiments.

A VALVE MOTION FOR SMALL HIGH-PRESSURE PUMPS.

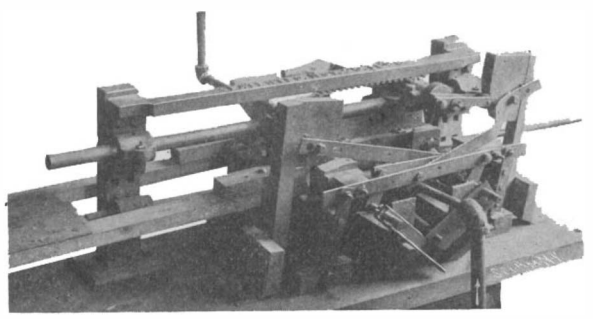
The use of high pressures with pumps of small dimensions presents difficulties, as the valves are liable to be kept open by the pressure. To overcome this drawback, Adolph Richter, 1138 First Avenue, Manhattan, New York city, employs a special device for pressing the valves firmly against their seats during the time they should remain stationary, the valves being released shortly before they are to be shifted.

The valves are turned by means of the levers shown at the end of the elevation, each lever being connected with one suction valve and one delivery valve by links and crank arms. These levers are struck periodically by an arm on the front end of a shaft which is journaled in a slide moving together with the pump piston and provided with a pinion rolling on a stationary rack. This same shaft carries at its rear end another



SIDE ELEVATION OF THE VALVE-GEAR.

arm which at the end of each stroke operates a set of toggle levers connected with spring arms exerting an axial pressure on the valves when the toggle levers are in line with each other. The parts are so timed in operation that the axial pressure on the valves is relieved before they are turned, and after they have



PERSPECTIVE VIEW OF A ROUGH MODEL OF THE VALVE GEAR.

been turned they are pressed against their seats tightly, thus allowing high pressures to be obtained without danger of leakage.

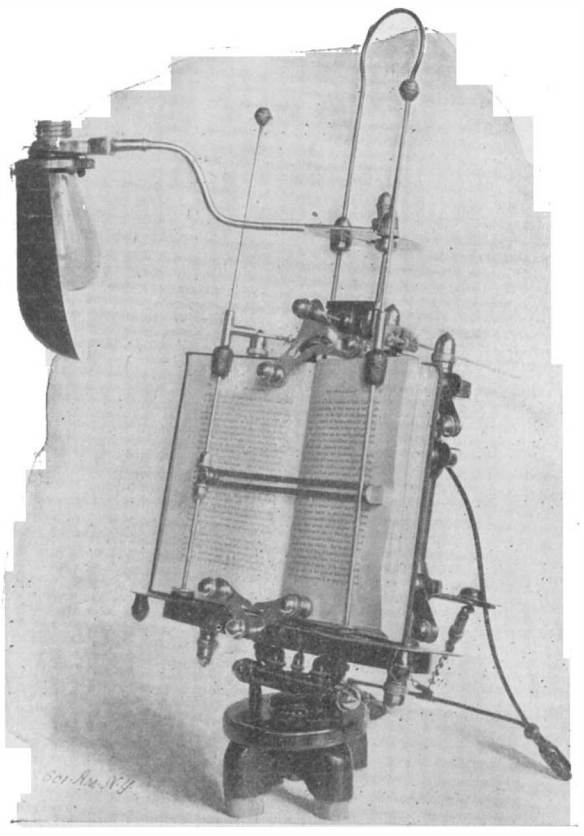
The Bressa Prize.

The Académie Royale des Sciences de Turin announces that a Prix Bressa of 9,600 francs ($1,920) is open to competition among investigators and inventors of all nationalities. The prize will be awarded to the person who, in the opinion of the Academy, made the most brilliant or useful discovery in the four years 1897-1900, or who produced the most celebrated work in pure or applied science. Works intended for consideration in connection with the prize must be sent to the president of the Academy before the end of next year. The contest will close December 31, 1902. The right is reserved to award the prize to an investigator whose work is considered to be the most worthy of the honor, even though he does not submit an account of it.

A NEW BOOK OR COPY HOLDER FOR TYPEWRITERS.

The difficulty of holding books, loose sheets, or documents used by public speakers, copyists, and typewriters is overcome by means of a holder recently patented by Burgess T. Montgomery, of 752 Ninth Street, Washington, S. E., D. C.

The device comprises a rotary pedestal which car-



THE MONTGOMERY COPY-HOLDER.

ries parallel supporting-rods. On these rods the book-holder is slidably mounted. In order to hold the book open (particularly a thick book), two spreaders are employed, one for the bottom, one for the top, of the page. One spreader is mounted on the book-holder, and the other on the parallel supporting-rods above the holder. The essential feature of each spreader is an axial rod passing through a bearing in a line at right angles to the plane of the book-holder, the rod having two bearing-arms offset to the same side of the axial center, so that when rotated about the center the arms will both pass off the book to allow the page to be turned. The axial rod of each spreader is longitudinally adjustable to accommodate books of different thicknesses.

Pivoted leaves or wings at the bottom of the holder form extensions for books of various sizes and thicknesses.

Another feature of the invention which deserves to be mentioned is a line-spacer or indicator pivotally mounted on a side-rod between two friction-clamps.

From the two parallel supporting-rods extending upwardly from the base an arm extends outwardly, which carries an electric incandescent lamp, so that the copy can be illuminated, if it be so desired.

The holder has every motion that can be demanded by the copyist or reader, and is provided with means for receiving all kinds of copy, thick or thin, long or short.

The Current Supplement.

The current Supplement, No. 1314, is commenced by a most interesting article on the maple sugar industry, accompanied by engravings showing the tapping of trees and the boiling of sirup. "Dock Equipment for the Rapid Handling of Coal and Ore on the Great American Lakes" is the continuation of an important article. "Some Links Between Natural History and Medicine" is by J. Arthur Thomson. "Progress of Agriculture in the United States" is by George K. Holmes. "A Model System of Water Works" is by F. O. Jones, and is accompanied by working drawings. The usual trade suggestions from the United States Consuls and Trade Notes and Receipts are published.

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RECENTLY PATENTED INVENTIONS.

Vehicles and Their Appliances.

BICYCLE-SUPPORT.—JAMES NEUBIGGING, JAMES EASTON, and JAMES BELL, Victoria, B. C., Canada. The bicycle-support consists of a head clamped to the lower brace of the bicycle-frame, to which head legs are loosely pivoted so as to be capable of spreading. The legs are provided with extension-arms at their fulcrum ends. A transverse locking member connects the extension-arms; and a retaining device holds the legs. In using the support, the legs are allowed to swing forward and are then firmly engaged with the ground by drawing the bicycle slightly backward. To disengage the legs, the bicycle is pushed ahead and the legs swung rearwardly and upwardly into engagement with the retaining device.

PLATFORM-WAGON.—TIMOTHY B. BENEDICT, La Grange, Mich. This platform farm-wagon is made much lower than the ordinary platform-wagon of the same height of wheels, whereby a load can be conveniently and quickly placed upon the platform. The vehicle is light, yet strong. Ordinary axles, bolster-blocks, bolster-hounds, reach, and sway-bar are dispensed with. The weight of the vehicle is equally distributed at the corners, and is equally supported at the wheels, which are beneath the corner portions of the platform. Each wheel is provided with a separate axle. Between the front axles a coupling is mounted. The tongue or pole permits the vehicle to be turned short with safety, and can be freely moved from side to side or up and down.

BICYCLE-FRAME MEMBER.—JAMES H. SULLIVAN, Cairo, Egypt. This invention provides an improvement in forks for bicycles. Tubular lower members and tubular upper members comprise the fork. The upper members are semi-cylindrical. A clamping-crown or block engages the members at the lower side, and has collars at its ends to embrace the lower members of the forks. A sleeve engages the members at the bend, and has portions extended through the collars and then turned outward. A latch turns outwardly. By the methods of fastening the members in the device as described, no brazing or soldering is necessary.

Mechanical Devices.

AIRSHIP.—ARISTARCHUS F. HUBBARD, Simmler, Cal. The airship has an air-plane adapted to transverse pivots at each end of the ship, each pivot being located at the edge nearest the center of the ship. Between the air-planes is a mast over which a rope extends attached to the outer end edges of both air-planes and then extending beneath the air-planes within the body of the ship. The planes are swung positively and their angular directions are maintained by means of drums to which the ends of the rope are attached. The air-planes control the vertical position of the ship. When it is desired to elevate the ship, the air-planes will be thrown into such a position that their forward edges are higher than their rear edges. When it is desired to descend, the air-planes will be oppositely adjusted.

SCUTTLE-LIFTER.—GEORGE BICKELHAUPT, Manhattan, New York city. The object of this invention is to provide a scuttle-lifter which can be easily opened or closed and automatically and securely locked in closed position. A lever has sliding connection at one end of a guideway on the skylight or scuttle. When a swinging motion is given to the lever a corresponding movement is given to the scuttle. A catch is carried by the lever to engage the guideway and to hold the scuttle in the position to which it has been raised. A latch locks the closed scuttle to its frame, with which latch the catch is operatively connected. A rope operates the latches to unlock the scuttle before it is opened by the lever.

WHEELWRIGHT'S IMPLEMENT.—MICHAEL M. MAY, Rulo, Neb. This invention is a novel machine for holding vehicle-wheels during the application of the tire, for permitting the wheels to be submerged in a tank immediately after the tire is placed in position, so as to cool the tire and shrink it on the felly. The machine is also useful for truing wheels and to prevent the dishing of wheels during the application of the tire.

CENTRIFUGAL MACHINE.—ANDREAS FREITAG, Amsterdam, Netherlands. Centrifugal separators are usually driven by belt and pulley. Water turbines and electric motors, however, have been applied directly to the separator shafts, thereby enabling the separators to be arranged in groups. With the driving belt, it is evident the machines must be arranged in rows. But the driving of centrifugal separators by electricity or by turbines is not readily applicable to existing machines, as in most cases the cost is considerable. The present invention attains the end by constructing the rotary bowl with buckets into which stationary nozzles discharge water. A trough receives the water; and a pump removes the water from the trough and discharges it again through the nozzles.

SELF-LOCKING PULLEY-BLOCK.—JOSEPH O. WALTON, 211 East Forsyth Street, Jacksonville, Fla. Mr. Walton has endeavored to secure the advantages of a rolling surface above a cramping pulley by which the rope is freely fed into the cramping groove, and also the advantages of a stationary binding surface to secure a positive lock. To this end his invention consists in combining with the cramping pulley a binding surface which rotates through the first part of the cramping action to allow the rope to be freely fed into the cramping groove and which locks and becomes stationary at the last part of the cramping movement so as to form a positive lock, thus securing the advantages of both forms of the device without the disadvantages of either.

Miscellaneous Inventions.

CROSS-HEAD FOR MINE-SHAFTS.—JOHN T. SEMMENS, Bald Mountain, Colo. The cross-head is arranged automatically to be locked, during its ascent or descent in its guideways to the hoisting cable, and to be automatically unlocked when its lowermost position has been reached so that the hoisting cable and its bucket may descend further into the mine-shaft.

FOLDING-CHAIR.—ADAM COLLIGNON, Westwood, N. J. The chair is a steamer-chair, each side bar of which has a longitudinal slot and one or more recesses in the lower wall of the slots. A back has downwardly extended members provided with pins passed through the slots in the side bars. The pins have heads to engage the outer side of the side bars to prevent their spreading. Legs are pivoted to the forward portions of the side bar. Stops limit the rearward movement of these legs; and arms are pivotally connected with the forward legs and with the back of the chair. By means of the recesses and pins the back of the chair is firmly held in its adjusted position. In folding the chair the front legs are carried up and back, whereupon the arms fall down almost parallel with the seat frame.

TRACER.—HENRY M. ENRIGHT, Manhattan, New York city. The primary purpose of the invention is to provide a means for folding and closing the tracer-wheel so that the entire device may be carried in the pocket without danger of tearing the cloth. The tracer-wheel is journaled in one end of a shank; and at opposite sides of the shank, plates are hinged. These plates are arranged to form a handle and to inclose the shank and tracer-wheel between them.

MAIL AND PACKAGE DRAWER.—PAUL P. I. FYFE, Concord, N. C. The drawer is constructed in two sections adapted to slide one within the other. For the sections of the drawer a casing is provided, which is so located that parcels can be placed in a section of the drawer outside of the building and removed at the inside of the building. The drawer has an outside combination lock connecting the two sections with the casing. If one not familiar with the combination attempts to open the drawer an alarm will be sounded.

EGG-TESTER.—CHARLES S. JEWELL, Rahway, N. J. The egg-tester comprises a casing having openings in its opposite side walls, and a runway extending between the openings. Through these openings the light of a lamp passes. The runway is inclined downward from its inlet to its outlet end, so that the eggs roll in the runway. As the egg passes along the runway it is viewed through one of the openings formed in the end of the casing. It is well known that a good egg is translucent when held to the light; that a bad egg is opaque.

SACK-HOLDER.—FREDERICK D. BLANCHARD, Lewiston, Minn. By means of this improved construction, the holder automatically adjusts itself to the length of the sack. For this reason the sack can be entirely filled, thus avoiding refilling. The holder will support a sack which has no hem. But little space is required for the device. The filling of bags is greatly facilitated.

CURTAIN-POLE RING.—JOHN KRODER, 270 Canal Street, New York city. The curtain-pole ring is split and has a hub to engage the ends. Integral retaining ends shaped as frustums of cones are carried on the ends. The hub has its ends tapered outwardly. The walls of these ends are contracted and reduced upon the ends of the split ring so as tightly to embrace the retaining heads and thereby prevent the split ring from opening. The ends of the split ring are held in position in the hub without the use of solder or other similar fastening means.

BICYCLE-BRUSH.—PEMBERTON DUDLEY, Philadelphia, Pa. In a baseboard, rollers are mounted which receive the bicycle-wheel. In the bottom and side walls of this baseboard, brushes are so mounted that they engage the tread and sides of the tire. Upon rotating the wheel the brushes clean the tire.

Designs.

BRACKET.—WILLIAM M. SCHRADER, Bucyrus, Ohio. The bracket supports a turpentine vessel beneath a hen roost in such a manner that parasitical insects must pass into the turpentine before they can reach the hens, and are, therefore, exterminated.

HALTER RING.—JAN BIRGEL, Dawson, N. D. The leading feature of this design consists of a straight member at one side, opposite which are converging straight members. Between these members are opposite inwardly curved members.

HARNESS HANGER HOOK.—JOHN STAGG, Paterson, N. J., and ARTHUR H. SPEAR, Manhattan, New York city. The hook consists of an elongated body portion having tongues at the ends inclined in opposite directions. The hook is to be used in fire-engine houses, and by reason of its peculiar construction the harness can be immediately dropped on the horses.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send your name and address to the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

Marine Iron Works. Chicago. Catalogue free.

Inquiry No. 97.—For manufacturers of ice-making machinery.

Catalogue of ice-making machinery of the latest pattern can be had from the York Mfg. Co., York, Pa.

Inquiry No. 98.—For manufacturers of laundry machinery,

Up-to-date laundry machinery manufactured by the Troy Laundry Machinery Co., Ltd., 258 Broadway, New York.

Inquiry No. 99.—For manufacturers of wire crimping rolls.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 100.—For channel iron or steel suitable for rails of iron fencing, 1¼ inch by ¾ inch, weighing about 1½ pounds per lineal foot.

WATER WHEELS. Alcott & Co., Mt. Holly, N. J.

Inquiry No. 101.—For machinery for manufacturing shovels and spades.

Yankee Notions. Waterbury Button Co., Waterb'y, Ct.

Inquiry No. 102.—For the address of the "Strowyer Automatic Telephone Exchange.

For bridge erecting engines. J. S. Mundy, Newark, N. J.

Inquiry No. 103.—For deflated toy, rubber, gas balloons.

Everlasting monuments of white bronze made by the Philadelphia White Bronze Monument Co., Philadelphia, Pa.

Inquiry No. 104.—For the manufacturer of the "Pennsylvania" high-wheel lawn mower.

Gear Cutting of every description accurately done. The Garvin Machine Co., Spring and Varick Sts., N. Y.

Inquiry No. 105.—For manufacturers of chemical fire engines.

Ten days' trial given on Daus' Tip Top Duplicator. Felix Daus Duplicator Co., 5 Hanover St., N. Y. city.

Inquiry No. 106.—For automatic numbering machines with six wheels.

Rigs that Run. Hydrocarbon system. Write St. Louis Motor Carriage Co., St. Louis, Mo.

Inquiry No. 107.—For manufacturers of twisted wire goods.

A fine line of coffee mills manufactured by Logan & Strobridge Iron Company, New Brighton, Pa.

Inquiry No. 108.—For typewriter adding machines.

Palmer Brothers, Mianus, Conn. Gasoline engine catalogue on request.

Inquiry No. 109.—For friction clutches, preferably a rim clutch.

Volney W. Mason & Co., friction pulleys, clutches and elevators, Providence, R. I. Catalogue on request.

Inquiry No. 110.—For machinery for mixing and filling cans of baking powder.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 111.—For machinery for making medicinal tablets by compression.

The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $4. Munn & Co., publishers, 361 Broadway, N. Y.

Inquiry No. 112.—For devices to cut up French fried potatoes.

For woodworking machinery of all kinds, The Fay & Egan Company, Cincinnati, O.

Inquiry No. 113.—For manufacturers or patentees of India rubber substitutes.

Send for catalogue of candle-making machinery. Homan & Co., Cincinnati, Ohio.

Inquiry No. 114.—For complete saw-mill outfits.

Saw-mill machinery and outfits manufactured by the Lane Mfg. Co., Montpelier, Vt.

Inquiry No. 115.—For seamless steel tubing ⅛ to 5-16 inch bore.

Turbine Water Wheel catalogues on application to Christiana Machine Co., Christiana, Pa.

Inquiry No. 116.—For a buttonhole moistener and opener, preferably Miller Bros.

Wanted—Revolutionary Documents, Autograph Letters, Journals, Prints, Washington Portraits, Early American Illustrated Magazines. Correspondence Solicited. Address C. A. M, Box 773, New York.

Inquiry No. 117.—For manufacturers willing to make wire novelties on order.

Machinery for twisting wire into all shapes and forms manufactured by Blake & Johnson, P. O. Box 7, Waterbury, Conn.

Inquiry No. 118.—For handles for rubber stamps.

Rushton Boats and Canoes. Morris Canoes. The H. & D. Folsom Arms Co., 314 Broadway, N. Y.

Inquiry No. 119.—For meteorological instruments.

Building plot 41 feet wide for sale; on Greene Street; old buildings; suitable for improvement. E. A. Cruikshank & Co., 143 Broadway, N. Y.

Inquiry No. 120.—For foot or hand power emery grinder with attachment for sharpening lawn mower knives, or such an attachment for an ordinary grinder.

Wanted. Pan Am. Exposition Patent Novelties suitable for souvenirs. Address J. M. B., 320 B'way, N. Y.

Inquiry No. 121.—For centrifugal gold-separating machinery.

Finest quality steam automobiles made in the world. Write Rochester Cycle Mfg. Co. Rochester, N. Y.

Inquiry No. 122.—For machinery for making excelsior.

Inquiry No. 123.—For manufacturers of small iron chain.

Shipping, weighing, dredging, quarrying and rafting chains made by the J. B. Carr Co., Troy, N. Y.

Inquiry No. 124.—For machinery for powder mills.

Inquiry No. 125.—Nor an automobile lawn mower (gasoline preferred) with detachable roller.

Inquiry No. 126.—For manufacturers of cigarette cardboard boxes.

The Rochester Folding Box Co., Rochester, N. Y., make the daintiest designs in cardboard boxes of all kinds.

Inquiry No. 127.—For manufacturers of merry-go-rounds.

Gillie Engine & Machine Co., Tonawanda, N. Y., steam riding galleries and whirling panoramas. Catalogues on request.

Inquiry No. 128.—For flexible steel ladder suitable for portable fire-escapes.

Inquiry No. 129.—For machinery for making fireworks.

Inquiry No. 130.—For electrically operated tools for lettering, carving and surfacing on granite or other stones.

Inquiry No. 131.—For machinery for the manufacture of brooms.

Inquiry No. 132.—For electrical, air beer pumps.

Inquiry No. 133.—For hand dynamos for experimental purposes.

Inquiry No. 134.—For manufacturers of leather link, for link and pin type of the flexible leather-link coupling.

Inquiry No. 135.—For machinery to manufacture fine emery cloth.

Inquiry No. 136.—For miniature arc lamps for alternating current with about ¼-inch carbon.

Inquiry No. 137.—For manufacturers of aluminium boxes.

Inquiry No. 138.—For manufacturers of telephone parts and appliances.

Simplex Interior Telephone Co., 431 Main Street, Cincinnati, O., manufacturers of telephone parts and accessories.

Inquiry No. 139.—For spring-hinges, locks and accessories for making show cases.

Inquiry No. 140.—For tachometers for giving directly the R. P. M. of a shaft, to be used in dynamometer tests of electric motors.

Inquiry No. 141.—For carpet cleaning machinery.

Inquiry No. 142.—For manufacturers of woven-wire willing to estimate on 20 miles of fencing.

Edward Darby & Sons, 233 Arch Street, Philadelphia, Pa., manufacturers of durable wire fencing.

Inquiry No. 143.—For a machine to straighten cold rolled round and square iron and steel shafting ¾ inch to 1¼ inch.

Inquiry No. 144.—For railroad track inspectors' tricycle, operated by gasoline or other motive power.

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(8075) C. H. asks: 1. How many accumulators are necessary to give off 30 amperes for 12 hours at 50 volts pressure, and what size? A. A good storage battery of 25 cells, each cell with 11 plates, about 11 inches square, will give about 400 ampere hours of discharge, provided the discharge is not more rapid than 50 amperes per hour. 2. About how many pounds of wire and what number are there on a 50-volt, 50-light generator at 16 candle power? A. Approximately 15 to 20 pounds on armature, and 50 to 60 pounds on field, according to type of machine. The sizes used would also vary, 18 to 20 on field, and 12 to 16 on armature. If you wish more exact information, cut out a bit of the wires and gage them. Measure the resistance of the field and from a wire table get the length by means of the number and resistance. The table will give the feet per ohm for the number. To find the length of wire on the armature, count the number of turns in one coil and determine the length of wire in one coil as closely as possible. From this the quantity of wire on the armature can be calculated.

(8076) E. M. J. asks: Have you any rule or formula for making induction or X-ray coils giving sparks? The rule I want is one by which I can find the size of the core, the amount of primary and secondary wire to be used to get any desired spark. A. There is no recognized rule or formula for finding the dimensions of an induction coil for a given length of spark; or rather every maker of coils has his own formula and does not disclose it. Nor are any two the same. You will find the dimensions of a large number of coils given in Bonney's "Induction Coils," which we can send you by mail for $1. SUPPLEMENT No. 1124, price 10 cents, gives full plans for a coil giving a 6-inch spark.

(8077) H. G. writes: I would like to know what a pair of hoisting engines will lift, size of the cylinder 20 by 32 inches, with an 80-pound steam pressure. Will you please show me how to work it? A. Find the actual horse power of the engine from the cut-off, mean steam pressure and speed as usual for steam engines. Multiply the horse power by 33,000, which will give the pounds that the engines will lift 1 foot in 1 minute. Divide this by the height in feet for the number of pounds it will lift the height in a minute, from which should be deducted the friction of the hoisting machinery. For example: 100 horse power engine × 33,000 = 3,300,000 foot pounds. If to be lifted 50 feet in one minute, then 3,300,000 ÷ 50 = 66,000 pounds, one-third of which should be deducted for machinery friction, leaving 44,000 pounds or 22 tons lifted 50 feet per minute.

(8078) C. C. asks: A boat using sufficient power to attain a speed of four miles

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an hour in still water, what would be the speed per hour, using same amount of power, going with the current, current running four miles per hour? A. The boat will have its own speed added to the velocity of the current, and will make 8 miles per hour, as measured on the shore, and in the contrary direction can only hold her position against the current.

(8079) F. S. R. asks 1. Is the simple motor described in your issues of December 8 and 15 to be run with one or more dry batteries? A. The diagram of the electrical connection shows four cells, two series of two cells each, used to run the motor. Dry batteries will not answer. 2. I have used No. 27 sheet iron, 8 feet in armature and 32 feet in field magnet; does this affect its running? A. The difference is that you have used a thinner sheet iron, and will not have so much weight of iron in the field and armature; hence you will have less magnetism and less power. There is no reason why the motor should not run with lighter fields. It will not run so heavy a fan. 3. How does the current revolve the armature? A. If the current is sent through in one direction, the armature turns in one direction; if in the other, the direction of the rotation is changed. If the direction of rotation is not as you wish it, change the wires which lead into the armature so as to reverse the current in the armature, leaving the field unchanged. The same can be accomplished by changing the direction of the current through the fields.

(8080) P. A. S. asks: 1. By what process may clam shells be softened so that they may be flattened without breaking? A. Clam shells cannot be softened so they can be flattened. 2. How can celluloid be made plastic so that it may be flattened? A. Celluloid can be softened and moulded by pressing under heated oil. 3. Why does the dissolving of NH_4Cl in water (as in making batteries) produce a lowering of the temperature? A. The simple solution of any substance in water is accompanied by a cooling of the water. This can be shown with common salt or sugar. It is very evident with ammonic chloride, and still more so with ice. It ought not to seem strange that this should be so, since heat is the means of dissolving the solid in all these cases. When no chemical action accompanies the mixing of a substance with water, the solution of it in water is always accompanied by an absorption of heat, a cooling of the water. Sodium sulphate dissolved in hydrochloric acid causes a fall of temperature far greater than the melting of ice can cause.

(8081) F. T. P. asks: 1. What is the temperature of liquid air? A. 312 deg. F. below zero. 2. How and by what kind of an instrument is it found? A. It is measured by a platinum thermometer. This depends upon the fact that the electrical resistance of pure metals is proportional to their temperature above absolute zero, and would have no resistance at absolute zero. See Scientific American for April 2 and April 23, 1898, price ten cents each. 3. Where could I find a good article upon the subject of liquid air? A. We can send you ten good articles on the subject for ten cents each. Also a good book, Sloane's "Liquid Air," price $2.50 by mail.

(8082) H. O. P. writes: Please inform me as to what an alum cell and bromide cell are, which are mentioned in your book, "Experimental Science," under subject of heat, page 189, twentieth edition, of what made and where they can be bought? A. An alum cell is a glass cell filled with alum water. The glass cell is shown on page 619 of "Experimental Science." A similar cell filled with carbon bisulphide in which iodine is dissolved till the solution is opaque to light is an iodine cell such as is used to show the transmission of heat without light. It is not a bromide cell, as you term it, but an iodine cell which is used for the purpose. They can be bought from dealers in physical apparatus, or made from two plates of glass and some thick rubber. Rubber tubing filled with fine sand may be used for the sides and bottom of the cell. Four screw clamps are required to hold the glasses together.

(8083) A. R. H. writes: I have collected a lot of bells of the form used for electric bells. I want to make a set of musical bells, and have all sizes. Could you let me know through your column or by letter how I could tune them? They are not very far or much out of tune as they are, but I do not know how to alter the pitch of the note one way or the other. A. To raise the pitch, turn the edge off in a lathe cautiously until the desired pitch is reached. To lower the pitch, make the edge thinner, removing metal from the inner or outer side at and near the edge.

(8084) E. N. C. writes as to an inexpensive battery for lighting one or two incandescent lights. A. You will find the plunge bichromate battery described in Supplement, No. 792, price ten cents, as convenient as any primary battery for lighting one or two small electric lamps.

(8085) J. T. asks: Has the problem of seeing to a distance by means of electricity ever been solved? If so, can you give me any information in regard to the latest work that has been accomplished in this direction? A. The sending of portraits or other pictures by electricity has been done for several years. We do not know any success in the direction of seeing to a distance by electricity.

(8086) F. D. P. asks: Can you inform me through your information department, in a general way, of the most practical and economical way to establish a telephone line of short length? I wish to construct two lines, one about one-quarter mile, the other about two and one-quarter miles, in length. I have never had any experience in this line, and will be pleased to have all the particulars. A. You will need line wire of galvanized iron, if the line is in open country; or insulated, if the line is in a town where other lines are run along the streets. Transmitters, receivers, calls, and lightning arresters, batteries, insulators, etc., will complete the outfit. The list of these, with prices and quantities, will be furnished by the dealers to whom you may write for rates. We can furnish you Poole's "Practical Telephone Handbook," price $1.50 by mail, which will give you instructions upon many points concerning the installation of the apparatus.

(8087) W. E. P. asks: Can you inform me how many convolutions there should be in the primary and the secondary of an induction coil designed to produce a quarter-inch jump spark, using a cell which gives about 6 amperes at 1½ volts? Also sizes of wire suitable for primary and secondary coils. A. The primary of most induction coils is wound with two layers of wire. For a quarter-inch spark use No. 24 cotton-covered copper wire. For secondary use about 8-ounce No. 36 silk-covered copper wire. Full data, drawings and instructions for making all parts of coils from ½-inch spark to 6-inch spark are to be found in Bonney's "Induction Coils," price $1 by mail.

(8088) M. N. asks: 1. Are lightning-rods a protection, or not, to a building, provided, of course, they are properly put on? A. Lightning-rods are a protection to a building when properly put on. They protect the building in two ways: 1. If the building is struck, the rods furnish a means of conducting the electricity to the earth without damaging the building. 2. They act as a path for electricity from the earth up into the cloud to neutralize its electricity before the lightning strikes. This may prevent the lightning from striking the building at all. This is probably often the case. For this service the rod gets no credit. 2. If they are not a protection, how did Franklin's discovery benefit mankind? A. Franklin's great discovery was not the invention of lightning rods. It was that lightning and electricity from the machine are identical, one and the same thing. He invented the lightning-rod after he found out what lightning is.

(8089) A. H. asks: Please inform me if any of the Scientific Americans contain instructions for making a storage battery that will register 15 volts or more. Please mention numbers. A. See Scientific American Supplement, No. 1195, price ten cents. You will require 8 cells to obtain 15 volts of pressure. One cell can give but 2 volts. To obtain 15 volts, join 8 cells in series.

(8090) O. H. H. asks: Does ice melt faster in a cool, damp cellar or in a warm, dry room? Have had different opinions on the same, and would like to know the correct one. A. The melting of a substance is proportional to the difference of temperature between that substance and the place where it is. There is no connection between the melting of ice and the moisture of the place where it is; or, rather, the place where ice is kept will soon be saturated with moisture, since ice evaporates at all temperatures without becoming liquid. Ice will, for these reasons, melt better in a warm place than in a cool place.

(8091) A. L. L. writes: My two boys are anxious to understand electrical testing and electrical-testing instruments. They say commence at first principles, as it puzzles them to understand voltage. They can master amperage and resistance, but voltage and potential difference seem to puzzle them. Would you kindly advise as to what book or books they had better procure? A. Your boys may think of this: A man pumps water from a trough up to another twenty feet above the first. From the upper trough the water flows down into the trough from which it was raised through a pipe, turning a wheel on the way. If this little example in water power is understood, it will be possible for the boys to apply it to the action of a battery or dynamo current. The battery or dynamo pushes the difference of potential up on its plus side to a level higher than on its minus side. Then from the higher level the electricity flows down again, doing work on the way—lighting a lamp, or turning a motor. The current of water can do work in proportion to its quantity. So can the current of electricity. This is measured and called amperes. The water is prevented from doing work in proportion to the friction along the pipe and the difficulty in turning the wheel. So the current of electricity is prevented from doing its work by the difficulty it has in forcing its way along the wire. This is resistance, and is measured in ohms. The water gets power in proportion to the height to which it is pumped. So the electricity has power to do work in proportion to the height to which it is raised. This is its difference of potential, or, as it is sometimes called, its electromotive force, or *voltage*. These names may later be distinguished from each other, but at first a distinction is hardly necessary. Electromotive force is also thought of as *pressure*. This is like the pressure the water would have in a pipe up which it is being pumped. The higher the pipe, the greater the pressure at the bottom. So a dynamo may produce a pressure of 50 volts, or 100 volts, or 5,000 volts, and the current will flow down with more violence as the pressure in volts is made greater. We recommend Thompson's "Elementary Lessons in Electricity," $1.40; Slingo & Brooker's "Electrical Engineering," $3.50.

(8092) F. P. S. asks: Can you inform me why a buzzing sound is heard at a simple electro-magnet which is connected with a small, shunt-wound dynamo driven by a water-wheel, when the dynamo is running. A. The dynamo is probably furnishing an alternating current, and the sound heard is the musical note corresponding to the number of alternations per second of that current.

(8093) W. B. writes: I am in want of exact information as to what extent lightning-rods prevent buildings from being damaged by lightning. I want reliable information, other than from interested parties who have rods for sale. A. We have frequently expressed our opinion that lightning-rods are a great protection to buildings, both in preventing lightning from striking and in conducting the discharge to the earth when it occurs. Scientific American Supplement, No. 998, price ten cents, contains a very valuable paper on the subject, from the pen of Prof. McAdie, of the Weather Bureau. His word ought to be considered as final.

(8094) J. T. V. writes: 1. In reading "Experimental Science," on page 350 I find the author makes the following statement: "In the search for perpetual motion, vain efforts have been made to discover a substance which could be interposed between the magnet and its armature, and removed without the expense of power, and which would intercept the lines of force, so as to allow the armature to be alternately drawn forward and released, but no such substance has ever been discovered." On page 481 there is shown a magneto-electric machine, deriving its power from a series of magnets. Inferring from the passage quoted that a permanent magnet continues to attract its armature indefinitely, will you kindly explain the effect the revolving armature has on the magnets of this magneto-electric machine, that renders them incapable of imparting motion, as I understand it does in time? A. The statement quoted from "Experimental Science" is quite true. There is no substance which can intercept lines of magnetic force which is not also attracted by the magnetic field. The magneto-electric machine derives its power from the fact that a coil of wire revolving in a field of force, so as to include a varying number of lines of force as it revolves, will have an electric current generated in it proportionate to the force required to revolve it; that is, proportionate to the number of lines of force which it cuts. This power is not lost by its exercise, but can be used indefinitely to produce an electric current. 2. Does the temperature affect the passage of the electric current through steel or copper wire? A. Yes; every conductor has its resistance changed by a change of temperature. Carbon has less resistance when hot than when cold. Metals have more resistance hot than cold. The change of resistance for one degree is called the temperature co-efficient. 3. Will you also please advise the number of shots it is calculated can be fired from the new 16-inch gun described in a recent issue of the Scientific American? A. The life of the 16-inch gun depends upon the intensity of the explosives. As to the number of shots that can be fired before the gun gives out, it probably cannot bear more than 100 shots at long range.

(8095) H. E. McC. asks: Will you please inform me if I may solder the wires to commutator segments? A. Armature wires are usually soldered to the commutator bars.

(8096) E. L. M. asks: I would like to inquire if the furnace of Supplement 1182 can be used for melting lead, Babbitt and such metals and kept at a steady heat? A. An electrical furnace cannot be used for melting metals at a low temperature. Its heat is so intense that the metals would be burned.

(8097) J. Z. asks: On a short telegraph line of about 300 yards, which instruments would you advise me to use—two five-ohm, or two twenty-ohm, instruments; or would it be just as good to use one of each, and why? A. Almost any sounder will work 300 yards. We do not know any reason for preferring one of these to the other.

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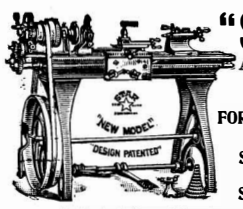

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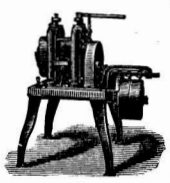

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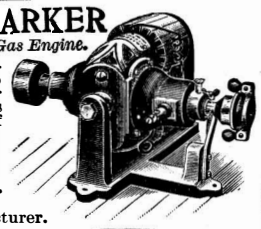

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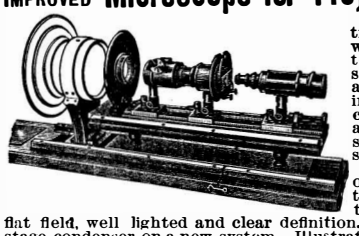

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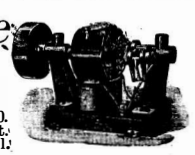

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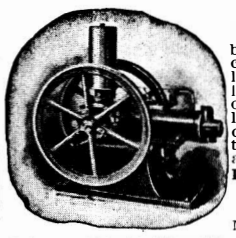

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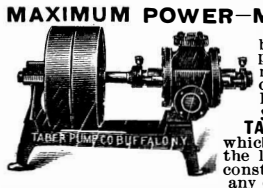

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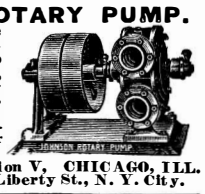

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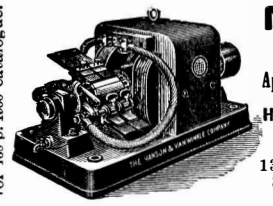

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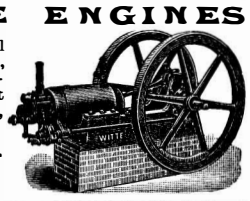

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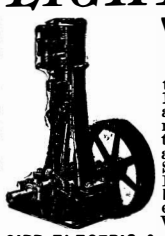

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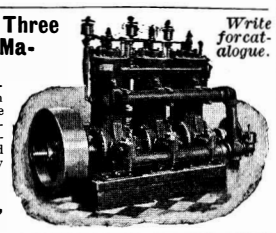

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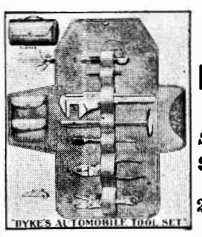

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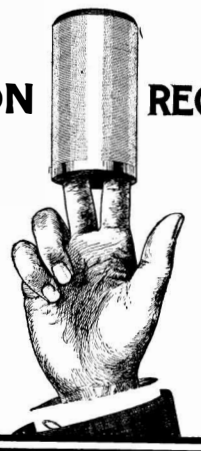

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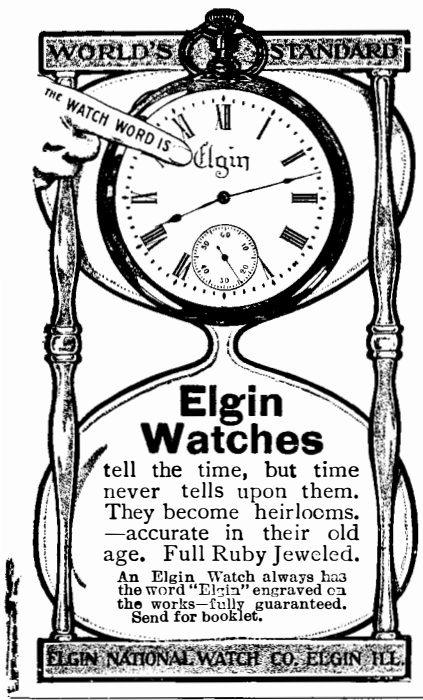
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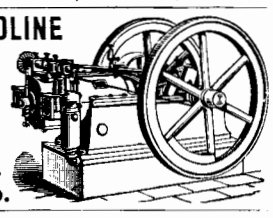

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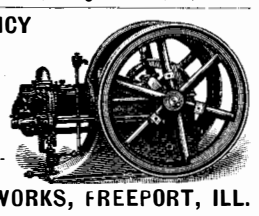

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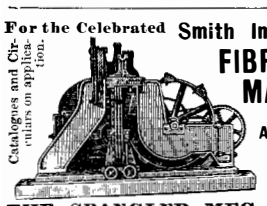

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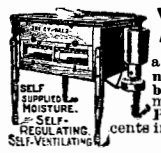

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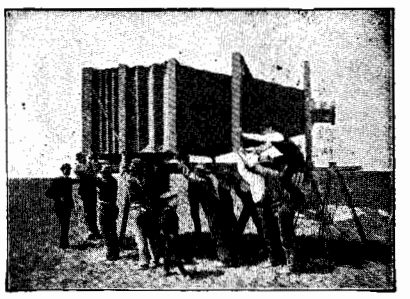

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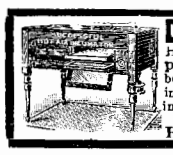

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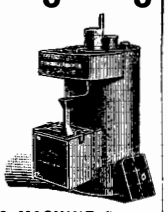

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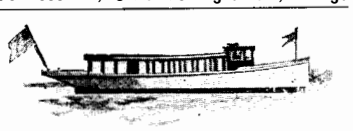

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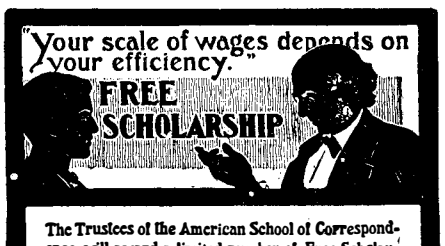

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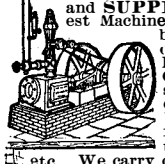
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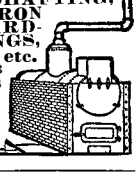
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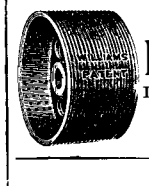
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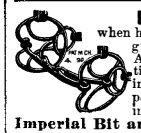
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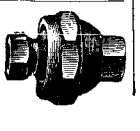
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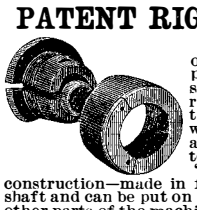
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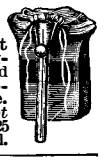

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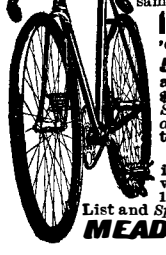
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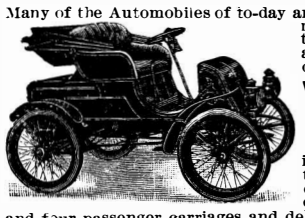

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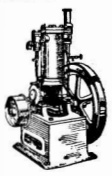

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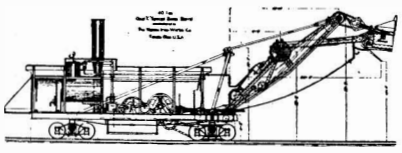

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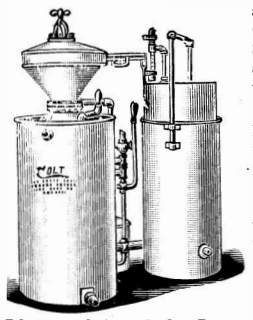

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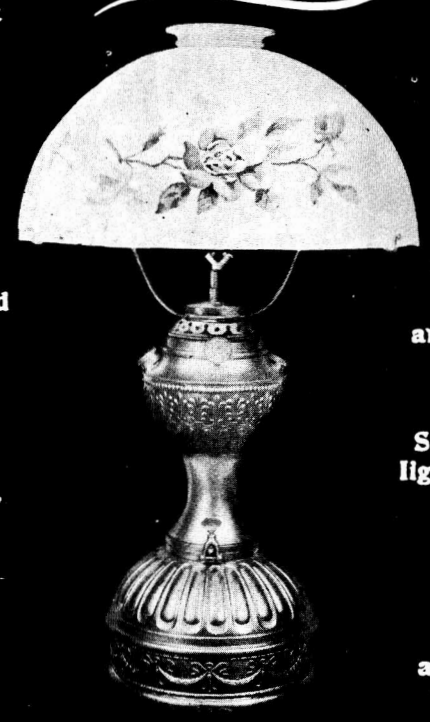

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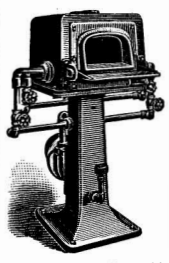

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